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A COLLECTION OF SPONGES FROM THE WEST COAST OF THE YUCATAN PENINSULA WITH DESCRIPTIONS OF TWO NEW SPECIES

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ABSTRACT

A collection of sponges made by Dr. Henry Hildebrand in the Gulf of Campeche, Mexico, is described. Nine species in seven genera are included, all within the Class Demospongiae. Two species are new: *Callyspongia stronglylophora* and *Axinella nanaspiculata*. Also recorded are specimens of (?) *Oligoceras hemorrhages* de L., *Ircinia campana* (Lamarck) de L., *Ircinia ramosa* (Keller) de L., *Haliclona rubens* (Pallas) de L., *Microciona juniperina* (Lamarck) new comb., *Axinella polycapella* de L., and *Higginsia strigilata* (Lamarck) de L. The taxonomic status of Lamarck's *Spongia juniperina* is discussed.

This report concerns a small collection of sponges made in 1951 by Dr. Henry Hildebrand in the Gulf of Campeche, Mexico. The sponges were taken in shrimp trawls in water 12 to 20 meters deep over shell sand off the coast of the state of Campeche, Mexico, between Campeche and Champotón. Although the sponge fauna of the Gulf of Mexico has been the subject of a number of previous studies, the sponges of the southern part of the Gulf are not well known. This is indicated by the fact that two of the nine species reported here are new.

Topsent (1889, 1894), in describing a collection of sponges from the Campeche Bank, listed 40 species, 13 of which were new. Of the nine species herein described only one, *Microciona juniperina* (Lamarck) = *Clathria copiosa* Topsent, was also represented in Topsent's collection. Topsent's papers are the only published accounts known to the present writer on the sponge fauna of the southern part of the Gulf of Mexico.

The specimens in the present collection are preserved in the dried state and are therefore not ideal for study. However, the specimens

were dried immediately after collection from deep water, and hence the skeletal elements are preserved in good condition. There is no reason to believe that some elements of the skeleton have been lost through being tossed about by the waves, as is sometimes true of beach-cast specimens.

I am most grateful to Dr. Henry Hildebrand of the Institute of Marine Science, University of Texas, for making this collection available to me for study. I am also indebted to Dr. Maurice Burton, British Museum (Natural History), and Dr. M. W. de Laubenfels, Dept. of Zoology, Oregon State College, for advice on several of the species, and to Dr. Frederick M. Bayer who granted me permission to study material in the U. S. National Museum. Dr. de Laubenfels has also made available to the writer a copy of his card index of sponge species which has proved to be of inestimable value.

Miss Shirley P. Glaser has kindly assisted in the preparation of drawings, and Mrs. Patricia J. Harris has helped with the photographic work.

CLASS DEMOSPONGIAE

Subclass Cornacuspongida

ORDER KERATOSA

Family SPONGIIDAE

(?) *Oligoceras hemorrhages* de Laubenfels, 1936

It is impossible to be certain of the identity of this specimen since the soft parts are not preserved. In skeletal and dermal characteristics the specimen agrees with this species, although it is possible that it belongs in the genus *Dysidea*. A study of the flagellated chambers would be necessary to decide the matter definitely. The principal fibers are packed with sand grains and broken spicules; the secondary ones have only a few included particles. The dermis is filled with broken spicules.

I am indebted to Dr. M. W. de Laubenfels for examining a section of the specimen and suggesting the above tentative identification.

Ircinia campana (Lamarck, 1813) de Laubenfels, 1948

Synonymy:

Spongia campana Lamarck, 1813, p. 385 [type: "probablement les mers d'Amérique"] Mus. nat. Hist. nat. Paris; Lamarck, 1816, p. 364; 1836, p. 553.

Stematuryenia scyphus Bowerbank, 1845, p. 407.

Polytherses campana, Duchassaing and Michelotti, 1864, p. 68.

Filifera campana, Schmidt, 1870, p. 31.

Hircinia campana, Schmidt, 1870, p. 31; Hyatt, 1877, p. 546; Lendenfeld, 1888, p. 178; Lendenfeld, 1889, p. 569; de Laubenfels, 1936a, p. 20; de Laubenfels, 1936b, p. 456.

Ircinia campana, de Laubenfels, 1948, p. 71; 1953, p. 514.

Description.

This common species is represented in the collection by one cup-shaped specimen, 14 cm high and 9.5x9.0 cm across the apical opening. The surface is conulose with conules varying from 2 to 6 mm in height and distributed over the surface at intervals of 2 to 5 mm. Oscula, varying from 2 to 7 mm in diameter, are located on the inside of the cup. In addition, some oscula, varying from 2 to 4 mm in diameter, are distributed irregularly over the outer surface of the cup, mostly near the attached end. The skeleton is made up of fasciculated fibers, the fascicles varying from 600 to 1400 μ in width. The main fibers range from 55 to 130 μ in diameter, the secondary ones from 15 to 35 μ . Some fibers are cored with foreign materials, chiefly broken sponge spicules and sand; others are devoid of included matter. Localized regions of the sponge have sand grains and foreign spicules adhering to the outer surfaces of the fibers. The filaments, distinctive for this genus, vary from 1.5 to 4.5 μ in diameter, enlarging terminally into knobs, 6.5 to 13 μ in diameter. The filaments are colorless, and their surfaces are provided with sparsely distributed yellow granules.

The specimen in the present collection differs from those described by de Laubenfels (1936a) in two ways: (1) the fibers are not as densely packed with foreign matter; (2) oscula occur on the outer as well as the inner surface of the cup. The first difference is probably of no significance, since the amount of foreign matter included in the fibers doubtless varies with the amount available in the environment. The second point is of interest since Lendenfeld (1888, p. 180) reports a similar distribution of oscula in the Australian species which he named *Hircinia calyculata*. De Laubenfels (1948, p. 71) regards Lendenfeld's species as a subspecies of *Ircinia campana*, a position perhaps strengthened by the oscular distribution of the present specimen.

Further distribution:

West Indies: St. Thomas (Duchassaing and Michelotti, 1864; Lendenfeld, 1888); Bahamas (Hyatt, 1877; Lendenfeld, 1888); Cuba (4 to 10 ft., Hyatt, 1877; Lendenfeld, 1888).

Florida: Key West (Hyatt, 1877; de Laubenfels, 1953); Biscayne Bay (Hyatt, 1877); Conch Reef (40 fms., Hyatt, 1877; Lendenfeld, 1888, 1889); Dry Tortugas (de Laubenfels, 1936a); west coast of Florida from off St. Andrew's Bay to Key West (de Laubenfels 1953).

Central America: Fort Sherman, Canal Zone (de Laubenfels, 1936b).

Other localities: Hyatt (1877) reports this species from La Paz, Lower California, and from Zanzibar; these records are not certainly of this species. Lendenfeld (1888) records it from Port Jackson, New South Wales; de Laubenfels regards this form as a subspecies of *campana*.

Ircinia ramosa (Keller, 1889) de Laubenfels, 1948

Synonymy.

Hircinia ramosa Keller, 1889, p. 345.

Hircinia ramosa de Laubenfels, 1934, p. 24.

Hircinia dickinsoni de Laubenfels, 1936a, p. 18. This name was given to the species by de Laubenfels when he realized that *ramosa* had been pre-occupied by Keller; later de Laubenfels argued that the West Indian species is synonymous with Keller's species.

Ircinia ramosa, de Laubenfels, 1948, p. 73; 1950, p. 12; 1954, p. 23.

Description.

One specimen in the collection is referred to this species with some uncertainty. In external form the colony is not unlike that illustrated by de Laubenfels (1950, pl. 1, fig. 1). Distal branches arise from a massive base but remain coalesced throughout most of their length. Only the terminal one or two centimeters of the branches are free; these vary in diameter from 1.5 to 2.0 cm and are rounded. The total height of the colony is 12.5 cm; at the base it measures 5 cm wide and 4 cm thick.

The surface is conulose with conules varying from 1 to 2 mm high and placed 1 to 4 mm apart. The dermis is covered with an abundance of foreign spicules and sand; the pores are sparsely distributed and vary from $16 \times 33 \mu$ across to $23 \times 43 \mu$ across. (Measurements of surface characters were made after soaking the specimen in a saturated solution of tribasic calcium phosphate.) The oscules occur at random over the surface and vary from 0.2 to 2.5 mm in diameter.

The skeleton consists of a loose network of fasciculated fibers cored with foreign spicules and some sand. The primary fibers measure 72 to 93 μ in diameter; the secondary, 21 to 50 μ . The mesh size varies from 400x300 μ to 1100x600 μ . The flesh is packed with filaments 2.5 to 3.0 μ in diameter, bearing terminal knobs measuring 7.5 to 10 μ in diameter.

Although it bears some resemblance to *Ircinia fasciculata* (Pallas) de Laubenfels, this specimen is referred to *I. ramosa* for several reasons. (1). In general form it is similar to the specimen described by de Laubenfels from Bermuda as discussed above. Its branch ends are rounded rather than acute as is true of branching specimens of *I. fasciculata*. (2). In surface characteristics it agrees with specimens of *I. ramosa* in the U. S. National Museum from Puerto Rico (USNM Nos. 22397, 22258). In these the dermis is packed to a greater or less extent with foreign spicules and sand. The pores are small and sparsely distributed. The oscules lack a pigmented rim unlike *I. fasciculata*. In two specimens of *I. fasciculata* studied (USNM No. 22-763, Bimini; YPM No. 705, Bermuda) the dermal detritus consists chiefly of sand grains arranged in a reticulate pattern around the pores which are larger, more abundant, and regularly distributed in the areas between conules. In a third specimen (YPM No. 644, Florida) siliceous spicules largely replace the sand grains but show the same reticulate pattern. Underlying the network of detritus are conspicuous bundles of filaments which arise on the conules and likewise form a reticulate pattern around the pores. In *I. ramosa* both detritus and filaments are more evenly distributed in the dermis. (3). The filaments are thin and have small knobs in comparison with those of *I. fasciculata* (see Table 1), although there is some overlap in these characteristics between the two species.

Further distribution:

West Indies: Off Puerto Rico (33 to 160 fms., de Laubenfels, 1934); Bermuda (shallow water, de Laubenfels, 1950).

Other localities: Bay of Assab, Red Sea (Keller, 1889). It is doubtful if Keller's species is identical with that of the West Indies, but in the absence of comparative material, de Laubenfels' conclusion that they are synonymous is accepted provisionally. Palau (2 meters) and Ponapé, Carolines (5 meters) (de Laubenfels, 1954). These forms are of doubtful synonymy with the West Indian species.

TABLE 1. *Ircinia ramosa* and *fasciculata* compared.
Ircinia ramosa (Keller) de Laubenfels

	USNM No.	USNM No.		de Laubenfels	de Laubenfels	YPM No. 1231
	22397	22258	Keller, 1889	1934, Puerto Rico	1950, Bermuda	Gulf of Campeche
	Puerto Rico	Puerto Rico	Red Sea			
Filament diameters	4 - 6 μ	3.3 μ	2 μ	3 μ	2 - 5 μ	2.5 - 3 μ
Knob diameters	10 - 11.5 μ	7 - 11.5 μ	---	10 μ	---	7.5 - 10.5 μ
Pore diameters	closed	closed	---	---	---	16x33 μ - 23x43 μ
Oscule diameters	---	---	---	---	2 - 4 mm	0.2 - 2.5 mm

	USNM No.	USNM No.		de Laubenfels	de Laubenfels	de Laubenfels
	23429	22763	YPM No. 644	YPM No. 705	1936a, Tortugas	1950, Bermuda
	Puerto Rico	Bimini	Florida	Bermuda		
Filament diameters	3.3 - 4 μ	4 - 6 μ	3.3 - 6 μ	1.6 - 5 μ	4 μ	5 μ
Knob diameters	9 - 11 μ	10 - 13 μ	13x10 μ - 16x11 μ	8 μ - 16x15 μ 83x50 μ - 116 μ	---	8 μ
Pore diameters	---	50x26 μ - 100x60 μ	closed	1.0x1.5 mm -	125 - 200 μ 3 - 7 mm	130 - 200 μ 5 - 10 mm
Oscule diameters	---	---	0.5 - 2.0 mm	2x3 mm		

ORDER HAPLOSCLERINA

Family HALICLONIDAE

Haliclona rubens (Pallas, 1766) de Laubenfels, 1936**Synonymy:**

Spongia rubens Pallas, 1766, p. 389; Duchassaing and Michelotti, 1864, p. 41.

Pachychalina rubens, Schmidt, 1870, p. 37 (identity uncertain; no specimen available); Wilson, 1902, p. 392.

Chalina rubens, Carter, 1882, p. 276.

Haliclona rubens, de Laubenfels, 1936a, p. 40; 1949a, p. 9; 1953, p. 519.

Description.

This is a common and widely distributed sponge in the West Indian region. The Gulf of Campeche specimen is a low, wide-spreading mass of anastomosing branches forming a colony 20 cm across and 8 cm high. The branches vary in width from 1 to 2 cm. The oscules are distributed irregularly over the surface and vary from 2 to 5 mm in diameter. The surface is provided with low conules.

The spicules are chiefly hastate oxeas of the following dimensions (range and mean of 180): length, 109 - 135 - 155 μ ; width, 1.5 - 5.5 - 8.0 μ . About 8 percent of the spicules are styles (range of 16) 86 - 145 μ by 4.5 - 7.5 μ ; 2 percent are strongyles (range of 4) 112 - 119 μ by 5.0 - 6.0 μ . Previous authors have not recorded the occurrence of the last two spicule categories.

TABLE 2. Spicule sizes of *Haliclona rubens*

Author	Locality	Size of oxeas
Carter, 1882	Bahamas, Florida	230x3 μ
Wilson, 1902	Puerto Rico	160x4 μ
de Laubenfels, 1936a	Florida	100x3 - 117x4 μ
de Laubenfels, 1949a	Bahamas	100x4 μ
Hartman	Gulf of Campeche	109 - 135 - 155 μ 1.5 - 5.5 - 8.0 μ

The spicules are packed in spongin fibers which have a reticulate pattern. The fibers vary in thickness mostly from 20 to 90 μ , with some up to 140 μ . The meshes are rectangular, triangular, or rounded and vary in diameter from 50x100 μ to 200x400 μ .

Further distribution:

West Indies: Guadeloupe, Viecques, St. Domingue, Cuba, St. Thomas (Duchassaing and Michelotti, 1864); Antilles (intertidal region to 12 fms., Schmidt, 1870); Nassau, Bahamas (Carter, 1882); south end of Bimini Group, Bahamas (de Laubenfels, 1949a); Playa de Ponce Lighthouse Reef, Puerto Rico (Wilson, 1902).

Florida: Long Key Island (Carter, 1882); Dry Tortugas (3 to 17 meters, de Laubenfels, 1936a; 6 to 20 meters, de Laubenfels, 1953); Florida (intertidal region to 12 fms., Schmidt, 1870).

Other localities: Carter's record (1882) of this sponge "in the sea about S. Australia" is questionable.

Family CALLYSPONGIIDAE

Callyspongia stronglylophora, n. sp.

Holotype: Yale Peabody Museum, No. 1229. One specimen. Collected by H. Hildebrand.

Locality: Gulf of Campeche. Taken in shrimp trawl between Campeche and Champotón, State of Campeche, Mexico. Depth, 12-20 meters. Bottom, shell sand.

Shape: Ramose, the numerous branches anastomosing frequently (Fig. 6). No definite basal attachment; since amount of sand adhering to surface is greater on one side of colony than other, it is probable that sponge was lying on sand bottom.

Size: Total length of colony—27.5 cm; width of colony—7 cm at one end, tapering to 1.5 cm at other; height of colony—(assuming colony was repent) 5 cm. Branches round to flattened in cross section. Rounded branches vary from 2.5 to 3.5 mm in diameter; flattened ends (representing fused branches) vary up to 10x2.5 to 3.0 mm in diameter.

Color: Dry sponge varies in color from cinnamon brown (Maerz and Paul, 1950, pl. 13, F - 7) in the case of branches with little sand to beige (Maerz and Paul, 1950, pl. 11, C - 2) in the case of branches with much sand.

Consistency: When wet the sponge is compressible, with resilient fibers; when dry it is compressible and easily torn.

Surface: Smooth, with occasional low tubercles or ridges.

Oscules: Distributed rather irregularly on the branches, with a tendency to occur in lines on the sides; largely absent from basal, sand-filled branches which were presumably in contact with the substratum. Oscules small in size, round (1 mm in diameter) or elliptical (1x1.5 mm), not raised above general surface of sponge.

Pores: Not apparent.

Skeleton: An irregular network of light yellow spongin fibers cored with long, thin strongyles. Dermal skeleton includes a network of principal fibers, 15 to 35 μ in diameter, forming irregular meshes varying from 275x500 μ to 575x700 μ across. Within the primary

network, secondary fibers, 5 to 15 μ in width, form a smaller reticulum with meshes varying from 70x100 μ to 275x575 μ across (Fig. 1).

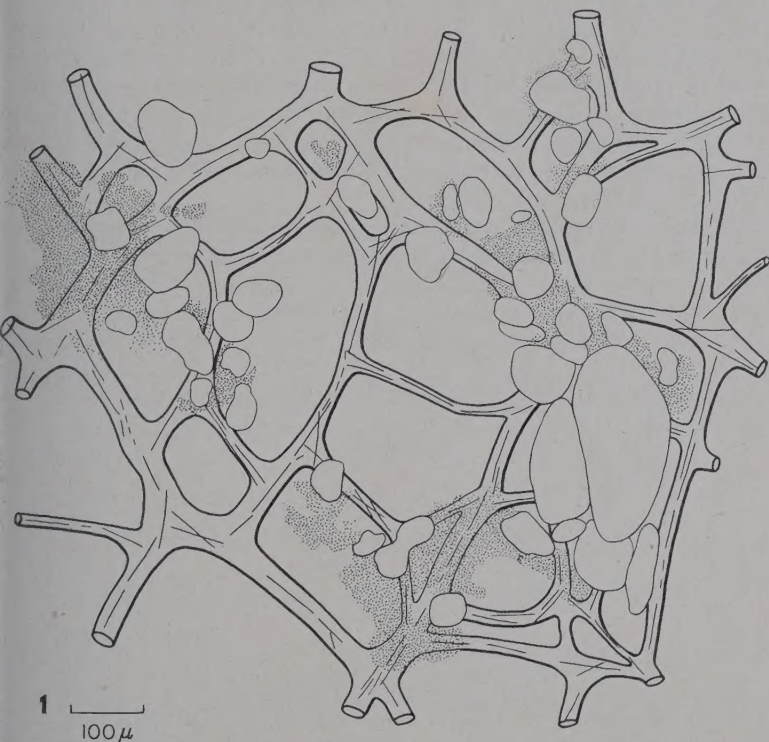


FIGURE 1. Portion of dermal skeleton of *Callyspongia strongylophora* n. sp. Sand grains (in outline) and detritus (stippled) are shown adhering to the surface. Thin strongyles core the spongin fibers.

Endosomal skeleton, a network of fibers with principal ones varying from 30 to 60 μ in width and connecting ones, 15 to 50 μ in width (Fig. 2). Meshes are square, rounded, rectangular, or trapezoidal in outline and vary greatly in size, ranging from 80x80 μ to 575x500 μ in dimensions. Occasional thorns (30 to 60 μ long) occur along the fibers. Where fibers reach surface, they end in rounded tubercles (40 to 75 μ long). Peripheral region of sponge (about 150 μ) packed with sand grains and foreign spicules which adhere to dermal membrane and surface fibers, but are not included in latter.

Sparsely distributed sand grains adhere to fibers throughout interior of sponge as well.

Spicules: Strongyles (Fig. 3) of following dimensions (range and mean of 200: length, 56 - 79 - 92 μ ; width 0.9 - 1.5 - 2.4 μ . Spicules are all enclosed in fibers, placed in a parallel fashion; interstitial spicules are absent. Dermal fibers chiefly unispicular, sometimes bispicular. Principal endosomal fibers have 2 to 8 spicules per cross section of fiber; connecting fibers have 1 to 6 spicules per cross section. Thorns and surface tubercles are also provided with spicules. About 1 percent of the spicules are oxeas.

Discussion. The specialized dermal skeleton divided into irregular primary and secondary reticulations places this species in the genus

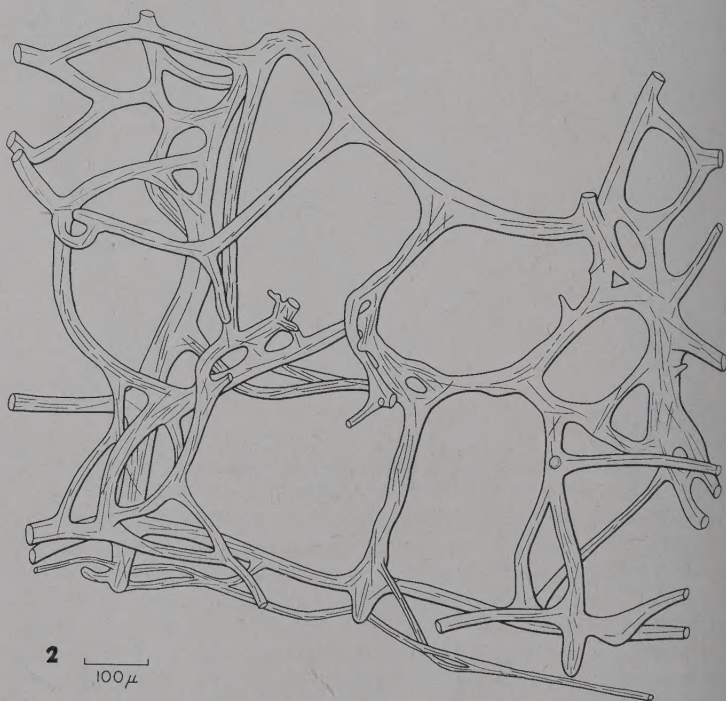


FIGURE 2. Section through skeleton of *Callyspongia strongylophora* n. sp. perpendicular to surface. Dermal skeleton below.

Callyspongia. Dr. Maurice Burton, who kindly examined a portion of the sponge and compared it with specimens in the British Museum (Natural History) has pointed out its similarity to *C. ramosa* (Gray) Burton from which it differs chiefly in spiculation, having strongyles rather than oxeas and toxas. The skeletal reticulation in the two species is very similar, as is the distribution of oscula. Burton (1934, p. 609) has noted that in Australian specimens of *C. ramosa* there is a tendency for some of the megascleres to be strongylote, but typical oxeas are always more abundant, and there are toxas present as microscleres.

In external form both *C. strongylophora* and *C. ramosa* (see Burton 1934, p. 603) resemble colonies of *Haliclona oculata* (Linnaeus). *C. strongylophora* is especially like specimens of *H. oculata* in the Peabody Museum collected off the Channel Coast of Normandy. These two species are readily differentiated by skeletal structures, however.

To the author's knowledge there are no other known ramose, strongyle-bearing species of *Callyspongia* with which this species can be confused.

ORDER POECILOSCLERINA

Family MICROCIONIDAE

Microciona juniperina (Lamarck, 1813) new comb.

Synonymy:

Spongia juniperina Lamarck, 1813, p. 444. [type: Indian Ocean; Mus. nat. Hist. nat. Paris]; Lamarck, 1816, p. 373; 1836, p. 563.

Thalysias virgultosa, Duchassaing and Michelotti, 1864, p. 86.

Pandaros juniperina, Duchassaing and Michelotti, 1864, p. 90.

Tenacia clathrata Schmidt, 1870, p. 56.

Clathria copiosa Topsent, 1889, p. 40.

Clathria clathrata, Wilson, 1902, p. 37.

Clathria jugosa Wilson, 1902, p. 37.

Rhaphidophilus clathratus, Topsent, 1932, p. 97.

Microciona prolifera (Ellis and Solander) Verrill, Vosmaer, 1935, p. 612-613. Vosmaer regards *Tenacia clathrata* Schmidt, *Clathria copiosa* Topsent, and *Clathria jugosa* Wilson as synonyms of *Microciona prolifera*.

Thalysias juniperina, de Laubenfels, 1936a, p. 105.

This common sponge of Florida and the West Indies has been known by the array of names listed above. The present writer follows Vosmaer (1935, pp. 608-611) in including it in the genus *Microciona*. This genus was established by Bowerbank (1862, p. 1109) with the type designated as *atrosanguinea* (a species first described

in full in 1864, p. 188). *M. atosanguinea* is an encrusting sponge, and this habit of growth has been considered typical of the genus by most subsequent authors. Vosmaer (1935, p. 606), on the basis of his exhaustive studies of *Microciona* in the Bay of Naples, noted a great variation in external form and other characters and gave a revised definition of the genus to include sponges with upright branches and laminae which had previously been included in other genera. The species in question here, *juniperina*, fits into Vosmaer's extended concept of *Microciona*.

Since *juniperina* has been known by such a variety of names in the past, a review of its nomenclatural history would seem to be justified. In 1813 Lamarck (pp. 444 and 446) described *Spongia juniperina* and *Spongia virgultosa*, the former from specimens from the Indian Ocean, the latter from specimens of uncertain locality but possibly from "les mers du nord de l'Europe." Both species are unrecognizably described by Lamarck who makes no mention of diagnostic microscopic characters, but fortunately Lamarck's specimens of *Spongia juniperina* are still extant in the Muséum National d'Histoire Naturelle in Paris and have been redescribed in detail by Topsent (1932, p. 97). Topsent (1933, p. 57) was unable to find the specimen upon which Lamarck based his *Spongia virgultosa*.

Duchassaing and Michelotti (1864, pp. 86 and 90) were the first authors to mention Lamarck's species. They considered one of their West Indian specimens as identical to *Spongia virgultosa* Lamarck and included it in their genus *Thalysias*. As Carter (1882, p. 267) has pointed out, the name of this genus is spelled four different ways in the paper of Duchassaing and Michelotti (1864): *Talysias*, p. 24; *Halysios*, p. 76; *Thalysias*, p. 82-83; *Thalysias*, p. 84-87. Three of these are obviously printer's errors, but there is no way of knowing which spelling the authors preferred, especially since Duchassaing in a later paper (1870, p. 38) spells it in a fifth way, *Thalysios*. Carter (1875, p. 196), probably the first subsequent writer to mention the name, adopted the spelling *Thalysias*, and de Laubenfels (1936a, p. 104) uses this spelling in redefining the genus probably because it is so spelled in Duchassaing and Michelotti's paper when used with the species *virgultosa* which de Laubenfels chose as the type. It seems advisable to retain the last-mentioned orthography.

In the same paper Duchassaing and Michelotti identified another sponge with *Spongia juniperina* Lamarck and placed it in another of their ill-defined genera, *Pandaros*. These two species are still unrec-

ognizable on the basis of the poor descriptions and figures of Duchassaing and Michelotti. De Laubenfels (*in litt.*) found their specimens at the University of Turin, has restudied them, and deposited them in the British Museum (Natural History).

As a result of his studies, de Laubenfels (1936a, p. 106) decided to establish *virgultosa* of Duchassaing and Michelotti as the type of the genus *Thalysias*, pointing out that the synonymy of this species with Lamarck's *Spongia virgultosa* as suggested by the above authors is doubtful. Since Lamarck's specimen could not be found by Topsent, this question cannot be resolved, and de Laubenfels has proposed that *T. virgultosa* be considered as Duchassaing and Michelotti's species. De Laubenfels concluded that *T. virgultosa* Duchassaing and Michelotti is synonymous with another species established by these authors, viz., *Pandaros juniperina*. Duchassaing and Michelotti regarded *P. juniperina* as identical to *Spongia juniperina* Lamarck, a conclusion borne out by Topsent's re-study of Lamarck's material. The specific name *juniperina* of Lamarck must therefore be used in place of *virgultosa* for the type of the genus *Thalysias*, a procedure followed by de Laubenfels, who states, "although Duchassaing and Michelotti did not place the specimen which they identified as *juniperina* in *Thalysias*, but instead in *Pandaros*, it is not at all typical of this latter genus, and since it appears to be the first species name correctly used with the form in question it would appear proper to employ *juniperina* as the species name." Actually both *Thalysias* and *Pandaros* are so widely defined by Duchassaing and Michelotti that it is difficult to speak of any species included in either as typical. Of the eleven species placed in *Thalysias* by these authors, four are unrecognizable and lost, and six of the others have been distributed subsequently in as many widely-separated genera. The remaining species, *T. virgultosa*, was established as the type of the genus by de Laubenfels. In *Pandaros*, one of Duchassaing and Michelotti's seven species is unrecognizable and lost; five others have been distributed among four other genera; the remaining species, *P. acanthifolium*, was established as the type of the genus by de Laubenfels. The valid reason for using the name *juniperina* is simply its prior usage by Lamarck for what is, on the basis of available knowledge, the same species. If the locality on the label of Lamarck's specimen is valid, i.e., if the specimen did come from the Indian Ocean, there is actually reason to doubt its synonymy with the West Indian species. De Laubenfels (1936a, p. 106) suggests that the label may be in error, and

the close morphological agreement of Lamarck's specimen with known West Indian specimens would seem to bear this out. Although there is no way of proving whether Lamarck's label is correct or not, it seems simplest to assume the latter for the present, at least until other specimens turn up from the Indian Ocean to enable a comparative study to be made.

The validity of the genus *Thalysias* as redefined by de Laubenfels is open to question as this author has pointed out himself. He says, "This genus is very closely related to *Microciona*, and in fact may technically be congeneric; practically the only difference is the more elaborate development of both horny fibrous skeleton and dermal skeleton." He goes on to suggest that only those species "which remain very thin without any extensive reticulation throughout their entire life history be regarded as *Microciona* proper, and if it should prove that there are none such, but that all which begin by being Microcionid later become Thalysid, that then the name *Thalysias* should drop into synonymy to *Microciona*. We do not have adequate data to justify such a step at present." It seems to the present writer that *Microciona prolifera* (Ellis and Solander) Verrill is of importance here as representing an intermediate between the two genera. Colonies of this sponge begin life as thin encrustations on shells and rocks; later vertical fingerlike branches appear, and eventually these anastomose to form large bushy colonies up to 20 cm in height and 25 cm in width. As de Laubenfels (1949b, p. 12) has pointed out, the branching colonies are characteristic of deeper water, although they are not infrequently found intertidally in the present writer's experience.

That *Thalysias* is congeneric with *Microciona* is borne out by the extensive studies of this group by Vosmaer (1935, p. 604 and ff.). Vosmaer does not mention either Lamarck's species or those of Duchassaing and Michelotti; presumably he did not recognize them as possible synonyms from the poor descriptions given by these authors. But he assigned to *Microciona* specimens of the species in question as reported by other authors under still different names (*Tenacia clathrata* Schmidt, *Clathria copiosa* Topsent, and *Clathria jugosa* Wilson). In his studies of the species of *Microciona* occurring in the Bay of Naples, Vosmaer noted great variation among the specimens in regard to the development of a distinct dermal spiculation, the regularity of the skeletal reticulation, the occurrence and abundance of several spicule categories, and the external form of the col-

ony. He stated that it would be possible to regard each specimen as a distinct species, but followed the opposite course by placing them all in a single, highly variable species, *Microciona prolifera* (Ellis and Solander) Verrill, thus identifying them with the common North American sponge. (Vosmaer retained the species *ambigua* for individuals with diactinal ectosomal spicules.) Vosmaer's extensive synonymies within the species *prolifera* are open to question in the opinion of the present writer. Thus, he would include the species *juniperina* in his extended concept of *M. prolifera*. *M. juniperina*, however, does show morphological differences from *prolifera*; the dermal skeleton tends to be better developed, the echinating acanthostyles and the microscleres are more abundant, and in external shape the former species commonly assumes a laminate form. (Laminate colonies also occur rarely in *M. prolifera*; one of Verrill's specimens from New England deposited in Yale Peabody Museum is cup-shaped.) These are differences of degree to be sure, but they assume a significance when it is realized that the two species are geographically isolated. *M. prolifera*, *sensu stricto*, is found on the Atlantic coast of North America from Beaufort, North Carolina, to Cape Cod and less commonly northward, whereas *M. juniperina* is found in Floridian and West Indian waters. To the present writer it seems justifiable to recognize them as distinct species.

In summary, the proposal is made to drop *Thalysias* in synonymy to *Microciona* since the two distinguishing characteristics noted by de Laubenfels (1936a, p. 104) intergrade (branching colony form *versus* encrusting form and distinct dermal specialization *versus* little such specialization). The specific name *juniperina* of Lamarck is retained for the West Indian sponge in question in spite of some uncertainty about the source of Lamarck's type specimen.

Description. The specimen of *M. juniperina* in the present collection is branching with a tendency for the branches to fuse and assume a laminate structure especially in the middle region of the sponge. Distally the laminae break up into short branches with subclavate ends. The colony is roughly ellipsoidal in outline, 8 cm in height and 13x8 cm across. The branches are 1 to 2 mm thick, the clavate ends, 3 to 4 mm thick.

The skeleton consists of a reticulation of spongin fibers, 40 to 90 μ thick, forming rectangular to rounded meshes measuring 90x150 μ to 350x400 μ . The most abundant spicules are styles and subtylostyles with the following measurements: length (range and mean of

200), 114 - 257 - 358 μ ; width (range and mean of 200), 3 - 10 - 20 μ . Of these some are packed in the dermis in an irregular manner, with a few placed perpendicular to the surface with their points directed outward. The dermis is not characterized by distinct spicule tufts, however, as mentioned by Topsent (1932, p. 98) and de Laubenfels (1936a, p. 105). The dermal spicules vary chiefly from 275 to 330 μ in length and 6 to 9 μ in width. Similar spicules occur in the endosome, both coring the fibers and interstitially. Here they are mixed with other size categories of styles and subtylostyles of the full range mentioned above. In a small number (about 0.5 percent) of the endosomal styles the rounded ends are microspined; a few strongyles occur also. In addition there are very fine subtylostyles distributed at random in the endosome, ranging in length from 82 to 297 μ and in width from 1.3 to 4.0 μ . These may represent growth stages.

The fibers are echinated by acanthosubtylostyles of the following sizes: length (range and mean of 100) 40 - 66 - 83 μ ; width (range and mean of 100), 3 - 7 - 10 μ . These spicules typically have spines on the head and in the mid-region of the shaft, the latter being smooth at its proximal and distal ends.

Two categories of microscleres are distributed at random in the endosome: palmate isochelas of length (range and mean of 100), 11 - 15 - 20 μ , and width (across the ends), 3 to 5 μ ; toxas, ranging in length from 33 to 106 μ and in width from 1 to 1.5 μ .

Further distribution:

West Indies: Guadeloupe, St. Thomas, Viecques (Duchassaing and Michelotti, 1864); Antilles (Schmidt, 1870); Puerto Rico (Wilson, 1902).

Florida: Dry Tortugas (somewhat deeper than 10 meters, de Laubenfels, 1936a); Florida (Schmidt, 1870).

Other localities: *Rhaphidophlus cratitius* (Esper, 1797, p. 195 Ehlers, 1870, p. 18, a species from the East Indies, should be mentioned here. It is similar in many respects to the West Indian species, *M. juniperina*, but possesses a peculiar category of microscleres. These are described by Ehlers as being hairlike and of a form varying from raphidelike to toxalike to C-shaped (spangenförmig?) and S-shaped to a form bent several times along its length. Vosmaer (1880, p. 159) first interpreted these as sigmas following Ridley and Dendy (1887, p. 152) but later was inclined to the view that they are modified toxas, following Hallmann's (1912, p. 187) comments about their similarity to the toxas of *Rhaphidophlus typicus* (Carter) Hall-

mann. Vosmaer concluded that *R. cratitius* is merely another variant of *Microciona prolifera*. De Laubenfels (1954, p. 137) described a specimen of *R. cratitius* from Ponapé, eastern Carolines, and placed it in the genus *Thalysias* (misspelling the specific name *cratita*). He retained the species as a distinct one chiefly on the basis of the peculiar toxas, a procedure in which the present writer concurs, transferring it, however, to the genus *Microciona*.

TABLE 3. Spicule measurements for *Microciona juniperina*

	Topsent, 1932	de Laubenfels, 1936a	Hartman
Dermal spicules	Thin subtylostyles 120-130 x 2-3 μ	Thin subtylostyles 170x2 μ to 210x4 μ	Styles and subtylostyles 275-329 x 5-10 μ
Endosomal spicules	Styles: 200-250 x 12-13 μ Subtylostyles: 250-300 x 4-6 μ	Styles and subtylostyles 170x7 μ to 165x9 μ	Styles and subtylostyles 114-257-329 x 3-10-20 μ Thin subtylostyles 82-297 x 1.3-4.0 μ
Acanthostyles	50x6 μ to 65x8 μ	42x4 μ to 50x5 μ	40-66-83 x 3-7-10 μ
Toxas	60 - 200 μ	27-36 x 0.4 μ	33-106 x 1-1.5 μ
Chelas	11-12 μ , up to 15 μ	11 μ	11-15-20 x 3-5 μ

Family AXINELLIDAE

Axinella polycapella de Laubenfels, 1953

Description.

Although this is apparently a common sponge in Floridian waters, it was first described in 1953 by de Laubenfels. Both Schmidt (1870) and Carter (1885a) had identified axinellids (presumably the species in question here) from the west coast of Florida as being synonymous with the Mediterranean form, *Axinella polypoides* Schmidt 1862, a species which Vosmaer (1935) in turn considered a variant of the Mediterranean sponge, *Axinella verrucosa* (Esper) Schmidt. There is thus some doubt about the validity of *polycapella* as a species, but this matter can be cleared up only by a careful comparative study of specimens from both localities.

There is one specimen (Fig. 9) of this species in the present collection, and this record extends the known range of the species from the west coast of Florida to the southern part of the Gulf. The specimen shows good agreement with de Laubenfels' description except for the much greater variability of the spicules in shape and size.



FIGURE 6. *Callyspongia strongylophora* n. sp. The type colony.
FIGURE 7. *Axinella nanaspiculata* n. sp. The type colony.

The surface is punctiform and hispid; the oscules vary from 1.0 to 2.5 mm in diameter. About 20 percent of the oscules are surrounded by a stellate pattern of radiating grooves; the remainder lack these. The skeleton is made up of a reticulation of spongin fibers in which the spicules are enclosed. Axially (about $1/5$ of the total diameter of a branch) the reticulation is dense. The axial fibers are wide (55 to 115 μ in diameter) and form meshes, rectangular to elliptical in outline, varying from $100 \times 75 \mu$ to $250 \times 200 \mu$ in size. The fibers originating in the axis arch over to the periphery of each branch, these extra-axial branches ending perpendicular to the surface. The extra-axial fibers are somewhat finer, ranging from 20 to 90 μ in diameter and form larger meshes, ranging from $125 \times 100 \mu$ to $350 \times 300 \mu$ in size. The connecting fibers of the extra-axial region are so arranged that in cross section they appear to form concentric circles around the axis (Fig. 8). Peripherally these concentric circles

TABLE 4. Spicule sizes in *Axinella polycapella* and *Axinella polypoides*

	<i>Axinella polycapella</i> (Data of Hartman)	<i>Axinella polycapella</i> (Data of de Laub- enfels, 1953)	<i>Axinella polypoides</i> (Data of Vosmaer, 1935)
Oxeas	Length, 186-257-358 μ Width, 3.5-15.5-21.5 μ (Range and mean of 138)	Length, 215-234 μ Width, 7-11 μ	Length, 180-380 μ
Styles	Length, 172-229-257 μ Width, 11.5-16.5-21.5 μ (Range and mean of 15)	Length, 178 μ Width, 7 μ	Length, 150-380 μ
Strongyles	Length, 157-257 μ Width, 15.0-21.5 μ (Range of 4)		
Intermediate strongyles	Length, 229-257-343 μ Width, 11.5-16.5-21.5 μ (Range and mean of 42)		
Subtylostyles	Length, 215 μ Width, 18.2 μ (one spicule)		

are closer together and form a denser network of fibers with a greater abundance of spicules; the obvious, dense cortical layer so formed measures about 500 μ .

The spicules range in shape from oxeas (67% of the total, Fig. 4a) to styles (7.5% of total, Fig. 4b) and strongyles (2% of total, Fig. 4d) with many intermediates between these categories (23.5% of total, Fig. 4c). Occasionally the spicules are provided with knobs (Fig. 4d) or spines (Fig. 4e). Spicule sizes are given in the accompanying table. *Further distribution:*

Florida: west coast, from Laguna Beach to Rebecca Shoal (5.5 to 18 meters, de Laubenfels, 1953).

Axinella nanaspiculata, n. sp.

Holotype. Yale Peabody Museum No. 1228. Collected by H. Hildebrand.

Locality. Gulf of Campeche. One specimen taken in shrimp trawl between Campeche and Champotón, State of Campeche, Mexico. Depth, 12 to 20 m. Bottom, shell sand.

Shape and size: Ramose, the colony arising from a basal attachment and branching at the base (Fig. 7). The basal branches anastomose to form broad, flattened branches, 2 to 3 cm across and 8 to 12 mm thick; these break up distally into digitate branches, some of which dichotomize. The distal branches vary from 4 to 14 cm in length, are rounded in cross section and vary from 8 to 12 mm in diameter; the side branches are from 1 to 4 cm in length and are thinner than the main distal branches. The total height of the colony is 25 cm; its width is 8 cm; its thickness, 5 cm.

Color: The dry sponge is tan with a red-purple tinge (Maerz and Paul, 1950, Pl. 13, C - 7, to Pl. 14, B - 7).

Consistency: The dry specimen is somewhat compressible and easily torn.

Surface: Slightly hispid and covered with pits, 0.2 to 0.4 mm across.

Oscules: Circular in outline; 1.5 to 2.0 mm across. Most tend to occur in vertical lines along the branches, 3 to 10 mm apart; others are scattered at random. Some are raised slightly above the general surface of the branches.

Pores: Not apparent in specimen studied.

Skeleton: A complex network of spongin fibers (tan in color) enclosing spicules (mostly oxeas, some styles and strongyles). The fibers

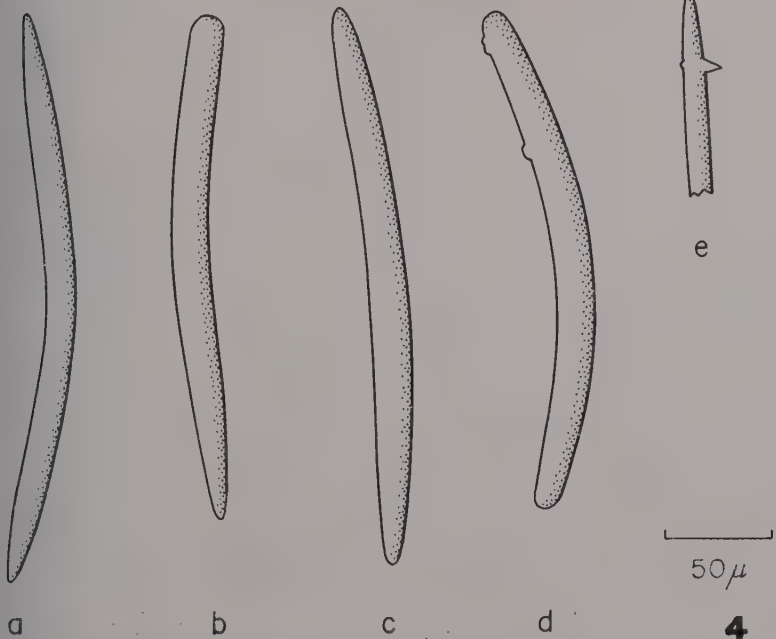
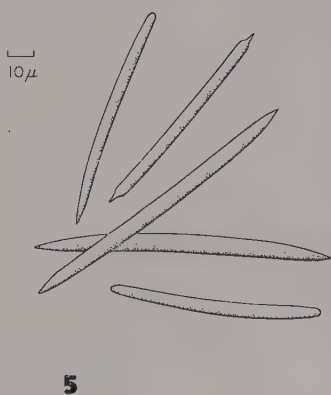
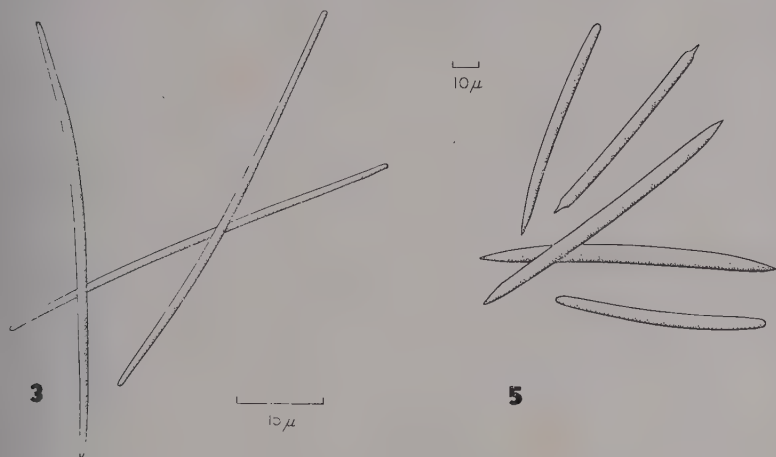


FIGURE 3. Spicules of *Callyspongia strongylophora* n. sp.

FIGURE 4. Spicules of *Axinella polycapella* de L. a, Oxea. b, Style. c, Spicule intermediate between oxea and strongyle. d, Strongyle with knobs. e, Portion of oxea with spines.

FIGURE 5. Spicules of *Axinella nanaspiculata* n. sp. From top to bottom: style, oxeas, and strongyle.

arise in the center of the branches, where they form a loose axial mass of parallel spongin and spicule tracts, and arch over to the periphery of the branches, reaching the surface perpendicular to it and the central axis (Fig. 10). The long tracts, both axially and extra-axially, are joined together by a meshwork of thinner fibers, also cored with spicules. In the peripheral region of the branches the network becomes denser as a result both of an increase in number of fibers and of the greater thickness of the individual fibers, forming a cortical layer, about 1 mm in thickness. Where the tracts meet the surface, they often end in small tufts of spicules (seldom more than 5 or 6) which give the surface a slightly hispid appearance.

The principal fibers vary in width from 35 to 85 μ and enclose from 5 to 12 spicules per cross section; the connecting fibers range from 14 to 25 μ in width, increasing peripherally to 25 to 35 μ . In the endosome the connecting fibers usually contain only one spicule per cross section, occasionally 2 or 3; in the cortical region, they bear up to 6 or 8. The meshes are rounded, square, or rectangular and vary from 45x45 μ to 290x160 μ .

The spicules (Fig. 5) are chiefly oxeas, straight or slightly bent often with the ends tapering off in a stepwise fashion. Their dimensions are: length (range and mean of 200), 56-112 - 132 μ ; width (range and mean of 200), 3.3 - 5.3 - 7.3 μ . About 4 percent of the spicules are styles with dimensions as follows: length (range of 8), 59 to 109 μ ; width (range of 8), 3.6 to 5.9 μ . About 1 percent strongyles are also present of dimensions: length (range of 3) 83 to 106 μ ; width (range of 3), 4.0 to 4.6 μ .

Discussion. This species differs considerably from the *Axinella verrucosa* (Esper) Schmidt complex discussed by Vosmaer (1935, p. 734) and from *Axinella polycapella* de Laubenfels (1953, p. 530). The *Axinella nanaspiculata* colony studied is smaller in overall dimensions than either of the other species; its spicules are decidedly smaller; its axial skeleton is less dense than in the others; it lacks the stellate pattern of grooves radiating from the oscules of the other species. (Vosmaer has observed great variation in the occurrence of the last character in *A. verrucosa*). Table 5 compares the dimensions of several characters of these species.

Axinella nanaspiculata differs from other species of *Axinella* known to the present author chiefly in regard to the small size of the spicules. The fact that the oxeas in this species are larger than the styles is

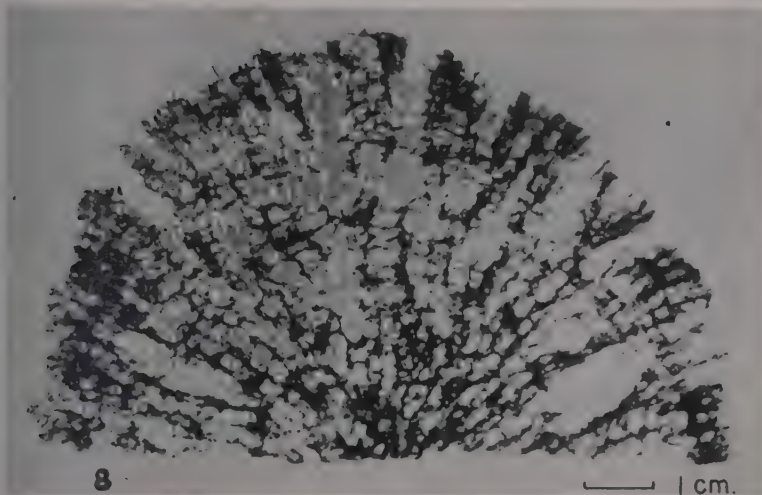


FIGURE 8. *Axinella polycapella* de L. Cross-section of half of branch.

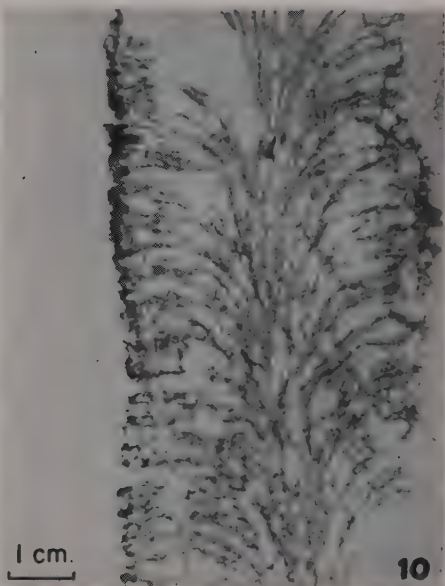
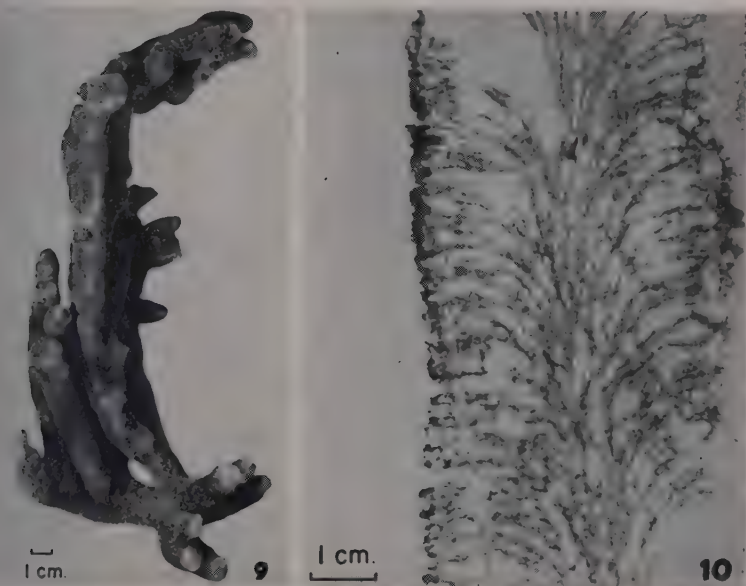


FIGURE 9. *Axinella polycapella* de L. Colony from Gulf of Campeche.
FIGURE 10. *Axinella nanaspiculata* n. sp. Longitudinal section of branch.

TABLE 5
COMPARISON OF AXINELLID CHARACTERS.

Species	Author	Length of <i>oxeas</i> (range)	Length of styles (range)	Total height of colony	Branch diameter	Oscule diameter
<i>Axinella nanaspiculata</i> Hartman	Hartman	56-132 μ	59-109 μ	25 cm	8-12 mm, up to 30 mm in flattened branches	1.5-2.0 mm
<i>Axinella polycapella</i> de Laubenfels 1953	de Laubenfels 1953	215-234 μ	178 μ	Up to 75 cm	15 mm	1.0-2.0 mm
<i>Axinella polycapella</i> de Laubenfels 1953	Hartman (2 specimens, Gulf of Mexico)	200-471 μ	200-286 μ	30 cm	10-20 mm	1.0-1.8 mm
<i>Axinella polypoides</i> Schmidt 1862 ¹	Vosmaer 1935	180-350 μ	150-380 μ			
<i>Axinella verrucosa</i> (Esper 1794) Schmidt	Vosmaer 1935	250-567 μ	200-734 μ	30-50 cm	3-10 mm, up to 50 mm in flattened branches	

¹ Vosmaer regards *A. polypoides* Schmidt as a synonym of *A. verrucosa* (Esper) Schmidt.

somewhat unusual in the genus, although it is also true of *A. poly-capella* (which differs from *nanaspiculata* in other ways) and several other species which differ in shape or spicule dimensions (see de Laubenfels 1935, p. 7).

Higginsia strigilata (Lamarck, 1813) de Laubenfels, 1953

Synonymy.

Spongia strigilata Lamarck, 1813, p. 450 [type: probably Indian Ocean: Mus. nat. Hist. nat. Paris]; Lamarck, 1816, p. 377; 1836, p. 567.

Higginsia coralloides Higgin, 1877, p. 291; Carter, 1885a, p. 205; Topsent, 1932, p. 112; de Laubenfels, 1949a, p. 17.

Higginsia strigilata, de Laubenfels, 1953, p. 534.

Description.

The Gulf of Campeche specimen agrees well with Lamarck's specimen as restudied by Topsent (1932). The sponge is branching with branches 2.0 to 2.5 cm thick, the total colony height being 12 cm. Spicule dimensions are given in Table 6, which compares them with specimens reported by other authors.

Further distribution:

West Indies: Carinage Harbor, Grenada (Higgin, 1877); Bahamas, especially south and east of Bimini (most abundant below 3 meters, de Laubenfels, 1949a).

Florida: west coast (Carter, 1885); off Tampa Bay (9 meters, de Laubenfels, 1953).

Other localities: Lamarck's specimen is labelled "probablement l'Océan indien"; Topsent believes this is an error and that the specimen was more probably from the Antilles. The following varieties of this species have been described: var. *liberiensis* Higgin, Cape Palmas, Liberia (Higgin, 1877); var. *arcuata* Higgin, Bantry Bay, Ireland (Higgin, 1877); var. *massalis* Carter, Port Phillip Heads, Victoria (Carter, 1885b; Dendy, 1897; Hallmann, 1916), Amboina (Topsent, 1897); var. *scabra* Whitelegge, Port Jackson, N. S. W. (Hallmann, 1916).

TABLE 6.
SPICULE SIZES OF *Higginsia strigilata*.

Author	Oxeas	Styles	Strongyles	Acanthoxeas
Topsent, 1932	Endosomal: range of length and width; 365x8 μ to 490x23 μ Ectosomal: length, 490-770 μ width, 4-7 μ	Length, 1150-1400 μ Width 10-16 μ		Length, 130-245 μ Width, 3-4 μ
Higgin, 1877	Two categories of oxeas are reported: stout, 630x25 μ slender, 630 or longer x 5 μ			Length 200 μ Width 4 μ
de Laubenfels, 1949a	360x16 μ			Range of length and width: 80x2 μ to 150x3 μ
Hartman	Length (range and mean of 182): 286-429- 529 μ . Width (range and mean of 182): 3.5-20.0-28.0 μ^2	6% of total megascleres. Length (range of 12): 343- 473, up to 1573 μ . Width (range of 12): 13-23 μ	3% of total megascleres. Length (range of 6): 286- 486 μ . Width (range of 6) 13-18 μ	Length (range and mean of 200): 36-99-172 μ Width (range and mean of 200): 2-3-4 μ

²There is no evidence of two categories of oxeas in the Gulf of Campeche specimen. Plots of both length and width measurements give normal curves.

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SOME LARVAL EUPHAUSIDS OF THE GENUS *STYLOCHEIRON* FROM THE FLORIDA CURRENT¹

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The material for the following notes on larval *Stylocheiron* was obtained during the course of investigations of the plankton of the Florida Current carried out by the Marine Laboratory of the University of Miami for the United States Office of Naval Research. During the latter part of 1952 and throughout 1953 a series of nearly a dozen stations were occupied in the Florida Straits for the study of the occurrence and vertical distribution of the larger zooplankton, especially the Euphausiacea, and their relation to the "Deep Scattering Layer." Each station was planned so that plankton samples were obtained from the surface to about 400 fathoms as often as possible throughout a twenty-four hour period. A depth-distance recorder (Miller et al, 1953) was used with all plankton hauls and counts were corrected to the equivalent of a one mile tow. Nets were modified from the Discovery type (Kemp, Hardy and Mackintosh, 1929) and catches were preserved immediately in 4% formalin in sea water, neutralized with borax.

I am indebted to the members of the staff of the Marine Laboratory who participated in the field work and to Dr. H. B. Moore who helped with advice. The work was supported in part by a grant from the National Research Council of Canada.

The species obtained were the same as those listed by Lebour (1949) from the Bermuda area and are as follows:—

Stylocheiron carinatum G. O. Sars.

S. suhmii G. O. Sars.

S. elongatum G. O. Sars.

S. longicorne G. O. Sars.

S. abbreviatum G. O. Sars.

S. maximum H. J. Hansen.

A few of the furcilia stages are known from each species except *S. elongatum*. Of the calyptopis stages, only those of *S. suhmii* are known from the work of Lebour (1926a). Descriptions of the early larvae may be found in the works of the authors listed in Table 1.

¹Contribution No. 147 from the Marine Laboratory of the University of Miami.

TABLE 1
EARLY LARVAL STAGES KNOWN IN THE VARIOUS SPECIES.

Species	Calyptopis	Furcilia
<i>carinatum</i>	Lebour, 1926a	Hansen, 1912
<i>suhmii</i>		Lebour, 1926b
<i>elongatum</i>		
<i>longicorne</i>		Frost, 1935
<i>abbreviatum</i>		Lebour, 1926b
<i>maximum</i>		Gurney, 1942, 1947; Lebour, 1949

Stylocheiron carinatum G. O. Sars.

This was by far the most abundantly captured species with both adults and larvae found in much greater numbers than any of the other species. It was possible on the basis of such large numbers to isolate the calyptopis and early furcilia stages of this species. A logical sequence of developmental stages was found from the first calyptopis up to the third furcilia. The third furcilia and later stages have been described by Hansen (1912).

Calyptopis I. (fig. 1, A, B and C).

The carapace of this stage is oval in shape, smooth in outline and covers most of the abdomen. The eyes are quite large, about one quarter of the length of the carapace viewed from above. The telson has six terminal spines, three pairs of laterals of which the innermost pair is the longest and a small pair of upper laterals. The larva is 1.75 mm in length.

Calyptopis II. (fig. 1, D, E and F).

The carapace has lost its regular outline and is flattened posteriorly. The abdomen shows traces of segmentation and projects out from the carapace a distance equal in length to the latter. The eyes have a small darkened central portion. The telson still has the same number and arrangement of spines as in the first calyptopis. The larva is 1.96 mm in length.

Calyptopis III. (fig. 1, G, H and J).

The abdomen is segmented in this stage and the eyes are tightly pushed against the carapace and have a conspicuously darkened central portion. There are seven instead of six terminal spines on the telson and the length of the outer pair of lateral spines is much reduced. The larva is 2.59 mm in length.

Furcilia I. (fig. 2, K, L and M).

This stage, characteristically, lacks any pleopods. The eyes are very

large with the bottom portion darkened and the lower edge showing the beginnings of numerous ommatidia. There is a small luminous organ on the eye. The rostrum reaches slightly beyond the eyes and is

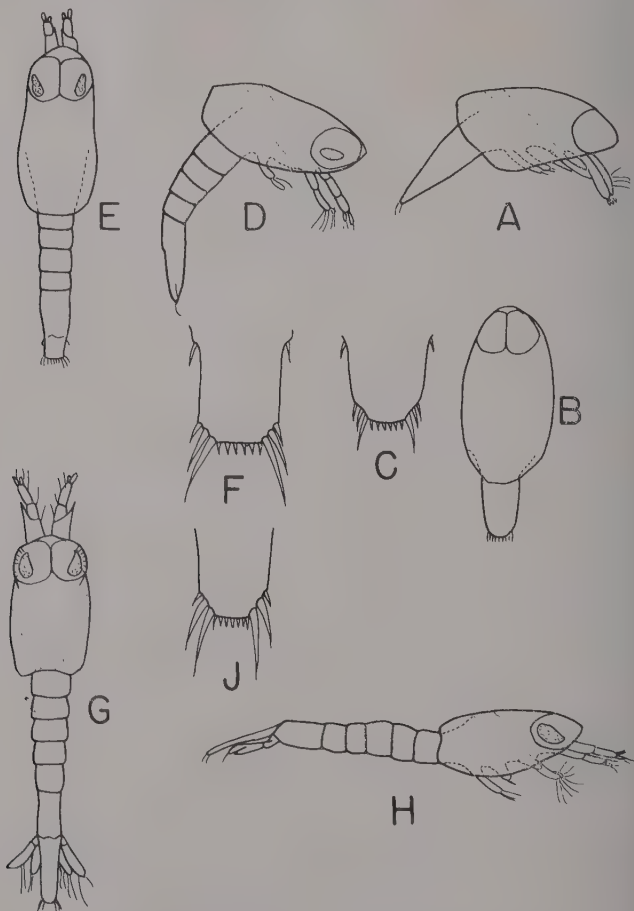


FIGURE 1. *Stylocheiron carinatum*. A and B. First calyptopis. C. Telson of same. D and E. Second calyptopis. F. Telson of same. G and H. Third calyptopis. J. Telson of same.

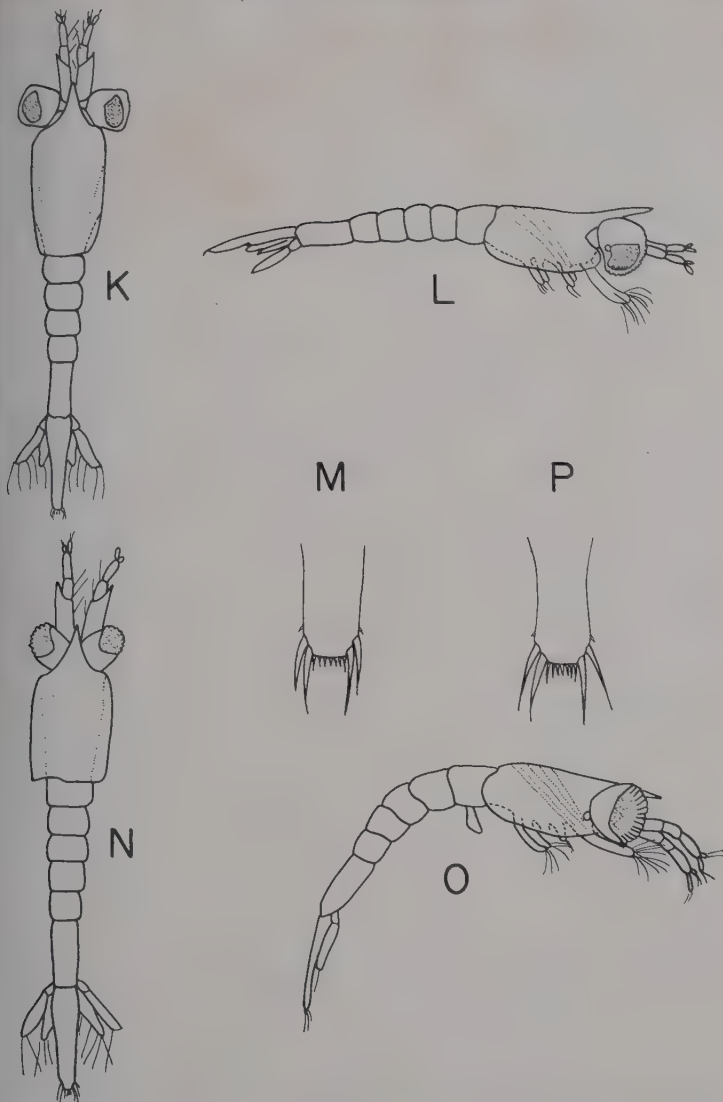


FIGURE 2. *Stylocheiron carinatum*. K and L. First furcilia. M. Telson of same. N and O. Second furcilia. P. Telson of same.

sharply pointed. The telson has seven terminal spines. The outer pair of lateral spines is much reduced in length and of the two remaining pairs, the inner pair is the longer. The larva is 2.65 mm in length. Furcilia II. (fig. 2, N, O and P).

There is a single non-setose pleopod. More than half of the area of the eye is darkened and it is beginning to show indications of two separate portions. The ommatidia are rather well marked off. There are seven terminal spines and two pairs of laterals of about equal length on the telson. The larva is 2.70 mm in length.

Stylocheiron elongatum G. O. Sars.

The larvae of this species have not previously been described. They were taken only occasionally and in small numbers. At one station, however, a series of larvae were taken which are almost certainly those of *S. elongatum*. They included specimens of larvae from the first calyptopis to the second furcilia in conjunction with a number of ovigerous females. The furcilia stages have the elongate eyes so characteristic of the two species *S. elongatum* and *S. longicorne*. The larvae of *S. longicorne* have been described by Frost (1935) and are much smaller than the larvae described herein. There seems to be no difficulty in assigning these furcilia stages to *S. elongatum* and the younger stages from a logical sequence of size and form up to the first furcilia.

Calyptopis I. (fig. 3, A, B and C).

The carapace of this stage is oval in shape and covers most of the abdomen. The whole body outline is very smooth. The eyes are large about one fifth of the length of the carapace and are close together. The telson has six terminal spines, three pairs of laterals of which the innermost is twice as long as either of the other pairs and a pair of smaller upper laterals. The larva is a large one, 2.52 mm in length.

Calyptopis II. (fig. 3, D, E and F).

The carapace is oval in shape and covers less of the abdomen than in the previous stage. There are six terminal spines on the telson and the innermost pair of laterals is three times the length of either of the other pairs. The larva is 3.08 mm in length.

Calyptopis III. (fig. 4, G and H).

The carapace is irregular in outline and the abdomen segmented. The telson has seven terminal spines. The innermost pair of laterals is twice as long as the next pair which in turn is twice the length of the outermost pair. The larva is 3.64 mm in length.

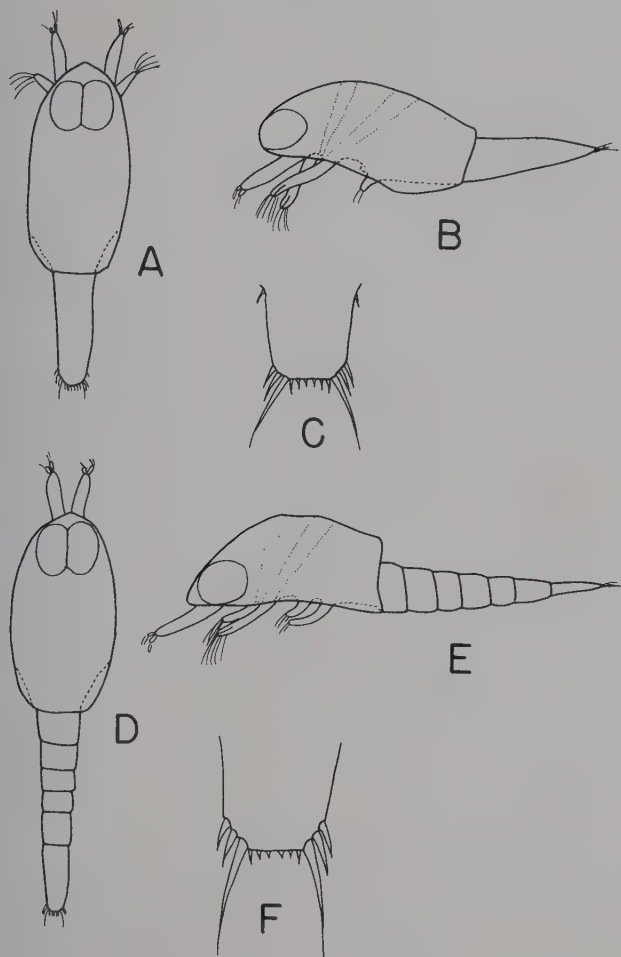


FIGURE 3. *Stylocheiron elongatum*. A and B. First calyptopis. C. Telson of same. D and E. Second calyptopis. F. Telson of same.

Furcilia I. (fig. 4, J, K and L).

The eyes are the diagnostic feature of this stage. They are covered by the carapace and have an elongate central portion which is darkened and is distinct from the rest of the eye. The anterior portion of the eye shows the beginnings of numerous ommatidia. The telson is

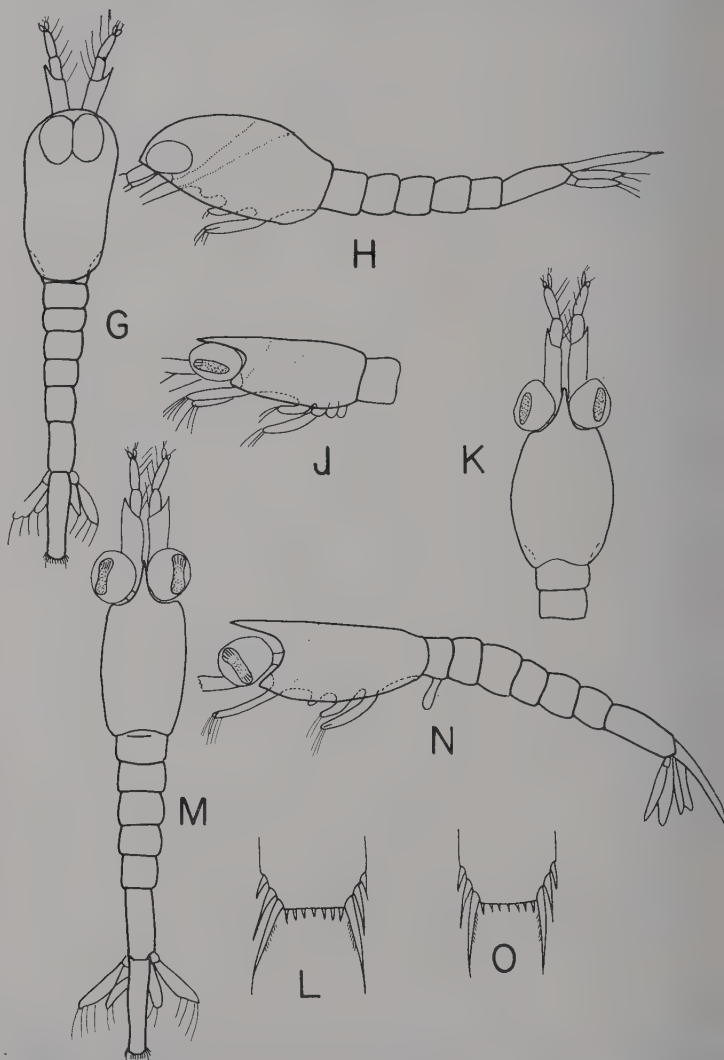


FIGURE 4. *Stylocheiron elongatum*. G and H. Third calyptopis. J. and K. First furcilia. L. Telson of same. M and N. Second furcilia. O. Telson of same.

the same as in the third calyptopis. The larva is 3.92 mm in length. Furcilia II. (fig. 4, M, N and O).

The eyes of this stage have a short stalk and are very like the adult condition. They have a darkened, elongate central portion which is slightly constricted in the middle. The ommatidia show up distinctly at the anterior end. The telson is the same as in the first furcilia. The larva is 4.20 mm in length.

Stylocheiron maximum H. J. Hansen.

The larvae of this species have not previously been known with certainty. A stalk-eyed Euphausid larva reported by Gurney (1942, 1947) and by Lebour (1949) was tentatively assigned to this species. With the present description of the larvae of *S. elongatum*, the only Atlantic *Stylocheiron* to which larvae have not been positively assigned is *S. maximum*.

A small number of these larvae occurred in a few hauls. Among them were several specimens of the second calyptopis and second furcilia. Previously only later furcilia stages had been described. Calyptopis II. (fig. 5, A, B and C).

The carapace is oval in outline and is equal in length to the uncovered portion of the abdomen. The eyes are slightly less than one quarter of the length of the carapace in width. The telson has six terminal spines, three pairs of laterals and one pair of smaller upper laterals. The innermost pair of laterals is twice the length of the pair adjacent. The larva is 3.92 mm in length. It has been assigned to *S. maximum* on account of its large size.

Furcilia II. (fig. 5, D, E and F).

The eye-stalks are very long and the eyes are large with a heavily darkened portion. The peduncles of the antennae are about as long as the eyes. The telson bears seven pairs of terminal spines, two pairs of laterals which are about equal in length, a pair of reduced laterals and the smaller pair of upper laterals. The larva is about 4 mm in length.

There is a considerable difference in the lengths of these larvae and the lengths of the larvae recorded by Lebour (1949) from Bermuda. She has figured what is presumably a fourth furcilia which measures only 2.24 mm. There is no doubt that they are larvae of the same species and yet even the second calyptopis which I have assigned to this species is nearly twice as long as the furcilia of Lebour.

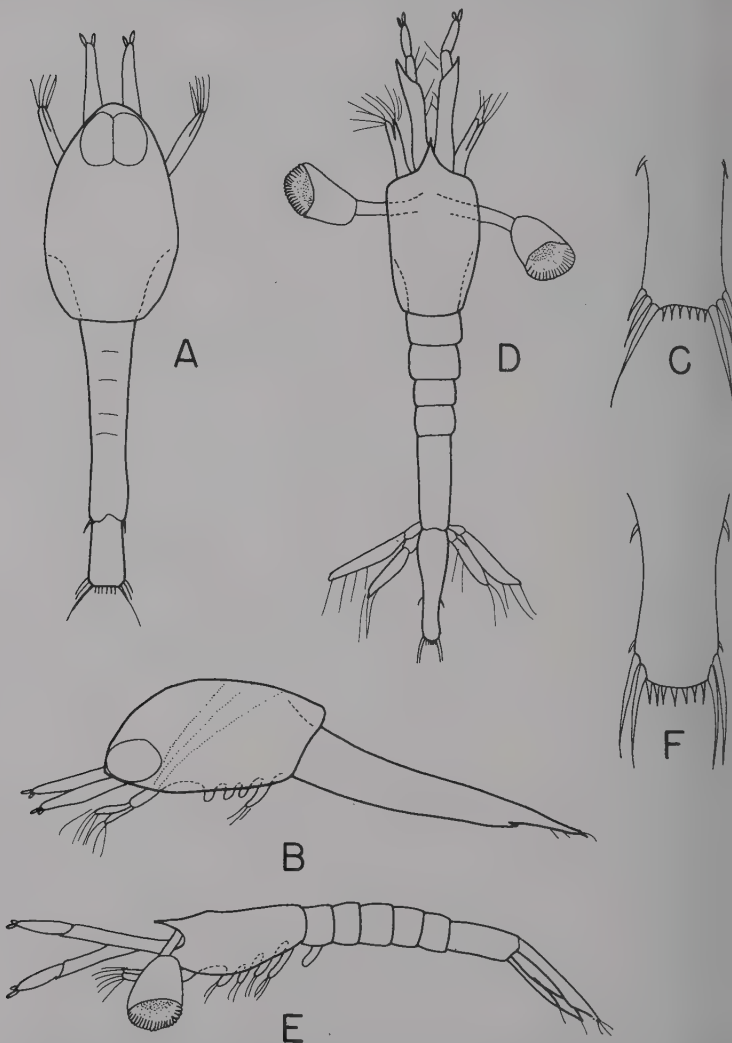


FIGURE 5. *Stylocheiron maximum*. A and B. Second calyptopis. C. Telson of same. D and E. Second furcilia. F. Telson of same.

Stylocheiron abbreviatum G. O. Sars.

The larvae of this species occurred in small numbers, mostly in the shallow layers. The furcilia stages from the fourth onwards have been described by Lebour (1926b).

Calyptopis I. (fig. 6, A, B and C).

This stage is very similar to the same stage of *S. carinatum*. The outline of the body is smooth and the carapace viewed from above is oval in shape. The eyes are large, about one quarter of the length of the carapace. There are six terminal spines on the telson, three pairs of laterals of which the innermost is longer than the other two and a small pair of upper laterals. The larva is 2.24 mm in length.

Calyptopis II. (fig. 6, D, E and F).

This stage again resembles *S. carinatum* but with the differences of the first calyptopis. The telson has six terminal spines and the first pair of laterals is more than twice as long as either of the other two pairs. The larva is 2.66 mm in length.

Calyptopis III. (fig. 6, G, H and J).

The carapace is short and the abdomen relatively longer than in the previous stage. In all the preserved material the abdomen was slightly bent. This flexing is apparently characteristic of the species for it was noted in the furcilia stages by Lebour. The lower portion of the eyes is slightly darkened. The telson has seven pairs of terminal spines, two pairs of laterals of about equal length, a pair of reduced laterals and a smaller pair of upper laterals. The larva is 2.87 mm in length.

Furcilia I. (fig. 7, K, L and M).

The carapace has a sharply pointed rostrum and a slight crest dorsally. The lower portion of the eye is darkened with numerous ommatidia beginning to show. The telson is of the same form as that of the previous stage. The larva is 2.94 mm in length.

Furcilia II. (fig. 7, N, O and P).

The darkened area of the eye is considerably larger in this stage. The telson lacks the pair of upper laterals. The carapace has a slight crest dorsally and the eyes are conspicuous and considerably larger than in the same stage of *S. carinatum*. The larva is about 3 mm in length.

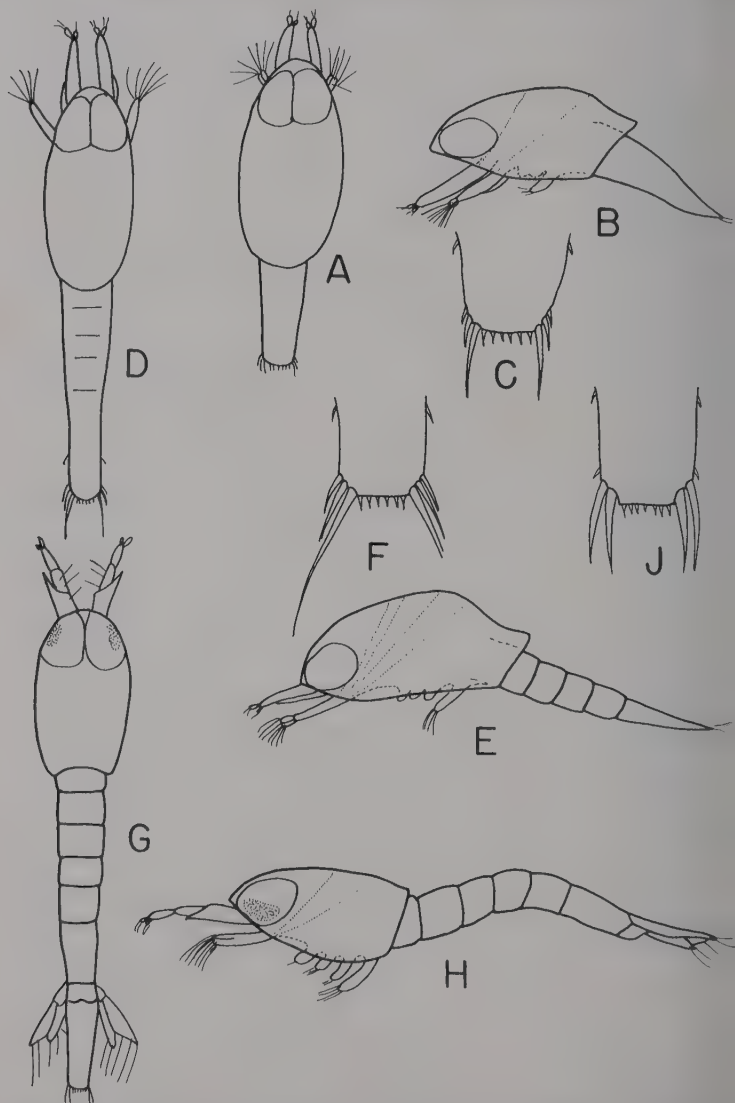


FIGURE 6. *Stylocheiron abbreviatum*. A and B. First calyptopis. C. Telson of same. D and E. Second calyptopis. F. Telson of same. G. and H. Third calyptopis. J. Telson of same.

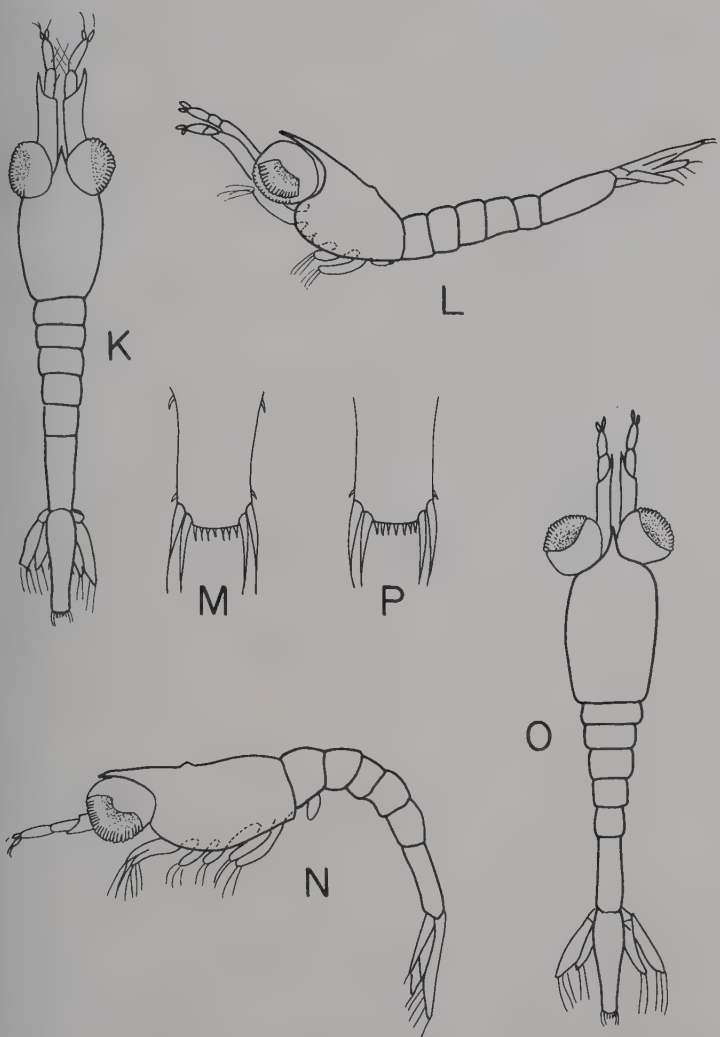


FIGURE 7. *Stylocheiron abbreviatum*. K and L. First furcilia. M. Telson of same. N. and O. Second furcilia. P. Telson of same.

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AN ECOLOGICAL SURVEY OF SOLDIER KEY, BISCAYNE BAY, FLORIDA¹

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ABSTRACT

The macroscopic intertidal and shallow water invertebrate and algal life of Soldier Key, a small island off the southeast coast of Florida, is described and certain zones of the shallow water are classified according to the most numerous inhabitant. These are, proceeding from the shore seaward, the *Echinometra* zone, the *Porites*-coralline zone, the *Thalassia* zone and the alcyonaria zone. These zones are believed to be characteristic of the other islands of the Florida Keys. The plants and invertebrates common to these zones are listed and some of their relationships discussed. All of the known animals and plants of the intertidal and shallow water of Soldier Key are listed along with their respective zonations.

INTRODUCTION

This is the first in a series of papers dealing with the marine invertebrates of some selected areas along the southeast coast of Florida and the Florida Keys and with a consideration of their numbers, zonal and geographical distribution and habitats. Soldier Key, an isolated island on the eastern border of Biscayne Bay, was selected for initial discussion as it offers a small area segregated from the surrounding intertidal areas by considerable expanses of water and rather swiftly moving tidal currents. In addition it has been visited by one of the authors many times over some period of years and by both of the authors three or four times a year for the last three years.

Since the inception of marine studies in the Biscayne Bay area little attempt has been made to discuss the rather basic problem of the numbers, distribution, or species of marine life in the area. Pearson (1936) published a paper on the distribution of the Ophiuroidea and this was followed in 1938 by Deichman's taxonomic survey of the Holothuroidea. In 1943 Smith published upon the Madreporaria. Weiss (1948) published the results of his studies of the seasonal occurrence of sedentary marine organisms in the Bay.

The ecology of Biscayne Bay has been discussed by Smith *et al* (1950) from the viewpoint of the hydrographic and chemical conditions with some observations on the abundance of plankton

¹Contribution No. 146 from the Marine Laboratory, University of Miami.

and fouling organisms, but general macroscopic marine life was not reported upon. Although not dealing with Biscayne Bay, Stephenson and Stephenson (1950) published a report upon the intertidal fauna of the Florida Keys which has become basic in this area and is the first approach to a survey of the macroscopic life of southeast Florida. In this work the general conditions of intertidal life are outlined and some attempt is made at a faunal list, although the main part is concerned with the intertidal zonation.

Much the same situation is found with regards to the algae. Taylor (1928) reported upon the marine algae of the Florida coast and this was followed in 1929 by a note adding to the list previously published and commenting upon the richness of algae in Florida in comparison with the West Indian islands. Isham (1950) in an unpublished master's thesis listed the algae of Dade County of which Soldier Key is a part, and this is the report upon which much of the following algal data are drawn.

The present paper will be followed by similar studies ranging from a mainland area such as Lake Boca Raton to Bear Cut in the Miami metropolitan area to the Ragged Keys, Largo Sound, and the Outer or Barrier Reefs, each, the authors believe, representing a distinct and important ecological habitat.

The authors wish to thank Frederick M. Bayer of the U. S. National Museum, Hilary B. Moore and Harding Owre of the Marine Laboratory, University of Miami, and Donald R. Moore of the Gulf Research Laboratory, for critically reading this manuscript and for many helpful suggestions in its preparation.

TOPOGRAPHY OF SOLDIER KEY

Soldier Key is a small island which lies on the eastern edge of Biscayne Bay (see Figure 1). It lies 5 miles south of Cape Florida which is on the south end of Biscayne Key, and about three miles north of the Ragged Keys, the latter introducing the main line of the keys which extend to the south and west, terminating in the Dry Tortugas. The mainland is 7 ½ miles to the westward.

Thus Soldier Key is an isolated island bordered on the east by waters with an average depth of about 20 feet extending to Fowey Rocks, 3 miles distant, which marks the drop off into the deep waters of the Florida Current. Fowey Rocks also marks the northernmost extension of the Florida Barrier Reef. To the northward and southward of the island extend shallow flats often bared during

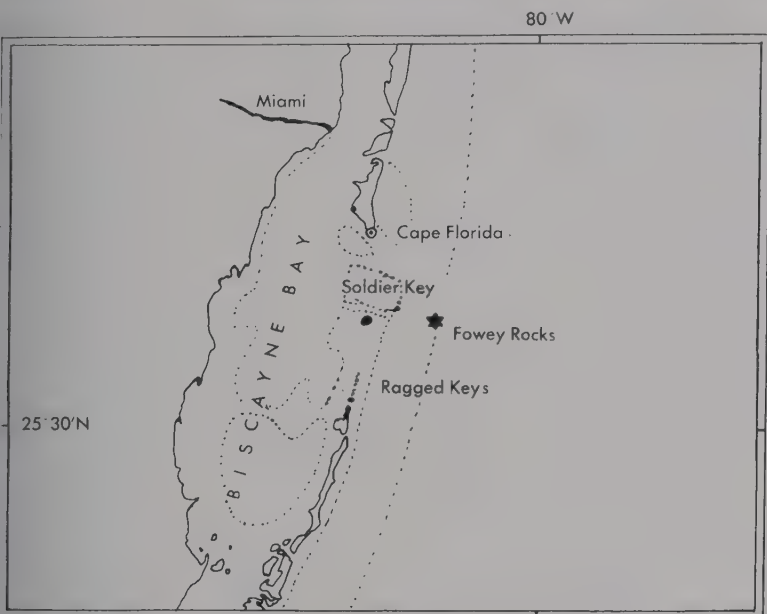


FIGURE 1. Map of Biscayne Bay and its approaches to show the position of Soldier Key.

spring tides and in parts known as the "safety valve" from the numerous branching and parallel channels running through the flats in an east-west direction to accommodate the ebb and flood of the tides into Biscayne Bay. To the westward the bay itself maintains an average depth of approximately 15 feet.

Soldier Key proper (Figure 2) is formed of Key Largo limestone of Pleistocene coral reef origin. For a discussion of intertidal erosion of this rock see Ginsburg (1953). The key is approximately 200 yards long by 100 yards wide with the axis in a N by E - S by W direction. It is nowhere more than about 6 feet in elevation and is sparsely covered by the typical grasses and shrubs of the key area described by Davis (1940, 1942) and Kurz (1942).

To seaward (east side) the upper platform (for definition of zonations see page 209) is covered as far as the high water mark by a lush growth of fleshy herbs such as *Sesuvium* and *Batis*. During average high tides the water extends up through the greatly eroded

limestone forty or fifty feet into this plant community. Along the edge of this zone is a separate growth of mangroves and buttonwoods. The Coast Pilot for 1894 describes Soldier Key as "very small and thickly wooded," but today the only extensively wooded area is on the south or lee side and is composed of white mangrove, *Logun-cularia racemosa*, black mangrove, *Avicennia nitida*, and the buttonwood, *Conocarpus erectus*. A sparse fringe of these trees extends northward but does not cover the northernmost end. The center of the key is covered by typical maritime growth but has been somewhat cleared, grass planted, and several buildings erected by the present owner. The western side of the key is more abrupt, the vegetation does not descend to the high water mark, and there is some expanse of jagged rock. Midway of the western side a small boat slip has been dug out and cement jetties extend outward for about 100 feet.

HYDROGRAPHIC DATA

According to the Tide Tables for 1953 Soldier Key has a mean range of tides of 1.9 feet with a spring range of 2.3 feet. The prevailing winds during the winter months, November through April, are northeast to east with occasional long hard northeasters. During the summer months the prevailing winds are from the southeast, and are usually gentle to moderate. Heavy wave action is almost entirely absent. The shoal waters surrounding the island effectually protect the shore and with the exception of infrequent hurricanes, prevent the build up of anything more than a strong chop. Although these conditions prevail during normal periods of weather, the visits of several hurricanes in succeeding years may almost entirely transform the area. Agassiz (1852) gives unusual high tides for Key West of 8 ½ feet above normal high tide and 10 ½ feet at Cape Romano. Biscayne Key, just north of the island, has been covered by water during several of these storms. The effect, observed by the author, of a near hurricane on Largo Dry Rocks will be discussed in a subsequent paper on the Florida Reefs.

Other than tides, the only available hydrographic data are those given by Smith *et al* (1950) and the following figures are taken from this paper. For the years 1945-46 the data are available on surface water temperature, salinity, dissolved oxygen, phosphate-phosphorus, and nitrite-nitrogen. They are presented in Table 1.

TABLE 1

Surface water temperatures, salinity in grams per kilogram, dissolved oxygen in milligram atoms per liter, phosphate-phosphorus and nitrite-nitrogen in microgram atoms per liter for Soldier Key (after Smith *et al*, 1950).

Date	water temp.	salinity	oxygen	phosphate-phosphorus	nitrite-nitrogen
7-7-45	31.7°C	37.11	.408	0.03	0.1
8-4-45	30.5	36.67	.451	.00	.0
10-27-45	24.70	33.06	.453	.03	.15
12-2-45	19.58	33.91	.436	.00	.0
1-6-46	21.79	36.22	.416	.00	.2
2-3-46	23.23	36.26	.492	.00	.2
4-28-46	25.15	36.86	.478	.00	.1
6-6-46	28.13	35.70	.400	.03	.1

From this table it may be seen that for the year of observation the range of temperature was 12.12 degrees with a low of 19.58°C in midwinter and a high of 31.7°C in midsummer. This rather high range of temperature is probably due to the shallowness of the surrounding waters and the resultant responsiveness to changes in air temperature through the entire water layer.

The salinities in grams per kilogram show a somewhat similar midwinter, midsummer fluctuation. Smith *et al* (*loc. cit.*) state that the low salinities of 33.06‰ and 33.91‰ in October and December respectively and the high of 37.11‰ in July correlate with the plotted rainfall. This range of 4.05 grams per kilogram is not excessively large and, from recent investigations in certain parts of Florida Bay near the Cape Sable region where there are vast expanses of very shallow water and high evaporation raising the salinity to 50.00 grams per kilogram or higher, it should be considered quite normal for the area.

Undoubtedly similar periods of high evaporation in the western end of Biscayne Bay raise the salinity well above the figure in the table. Long range observations for all of these data would undoubtedly change the picture considerably.

In common with other areas of Biscayne Bay the waters around the island are often supersaturated with dissolved oxygen. A glance at the table shows that the area has a high temperature and high salinity, features which should give a lower dissolved oxygen content. Possibly increased biological activity in the large *Thalassia* beds may account for it.

Smith *et al* (*loc. cit.*) found very little phosphate or nitrite in the waters around Soldier Key or in Biscayne Bay in general. They report that the near lack of phosphates may be due to the phytoplankton using up the phosphate in the surface layers and a corresponding lack of return in the Bay region from upwelling deeper waters. In a later paper by Miller (1952) who studied an enclosed body of water on Key Biscayne, the next island to the north of Soldier Key, it was found that the phosphate content decreased in direct relation to the increase of sedimentation and this may play a role in general lower phosphate content in the entire Bay region.

Although nitrites are negligible in most of the areas near open water the decay of organic matter in the shallow waters may account for a rise in nitrite content. For a resumé of stations and values see the paper by Smith *et al* pp. 122-125.

ECOLOGICAL SURVEY

Description of ecological zones and areas.

Ecological zones.

A. Upper platform.

The upper platform is a low rocky shelf extending from the true land vegetation seaward to the abrupt drop of the platform face. This platform may be quite smooth or deeply eroded into sharp pinnacles of rock which may be difficult to walk on. This area is partly covered at high tide. The Stephensons (*loc. cit.*) have distinguished within the upper platform four color zones extending from the seaward edge towards the land: yellow, black, gray and white depending upon the dominant algal growth, exposure, etc. We do not use these zones in the present paper since at Soldier Key they are not prominent.

B. Platform face.

The platform face is a more or less abrupt drop varying from a slight incline to the perpendicular, or even strongly undercut by wave action. It extends from the seaward edge of the upper platform to the shoreward edge of the lower platform. This area is usually exposed at low water and wholly or partly covered at high water. It averages about two feet in height and is generally covered by a yellow algal growth. This face is probably the result of wave action on the rocky shore line.

C. Lower platform.

The lower platform is a rocky shelf extending from the foot of the platform face to seaward. It may be of varying widths (at Soldier

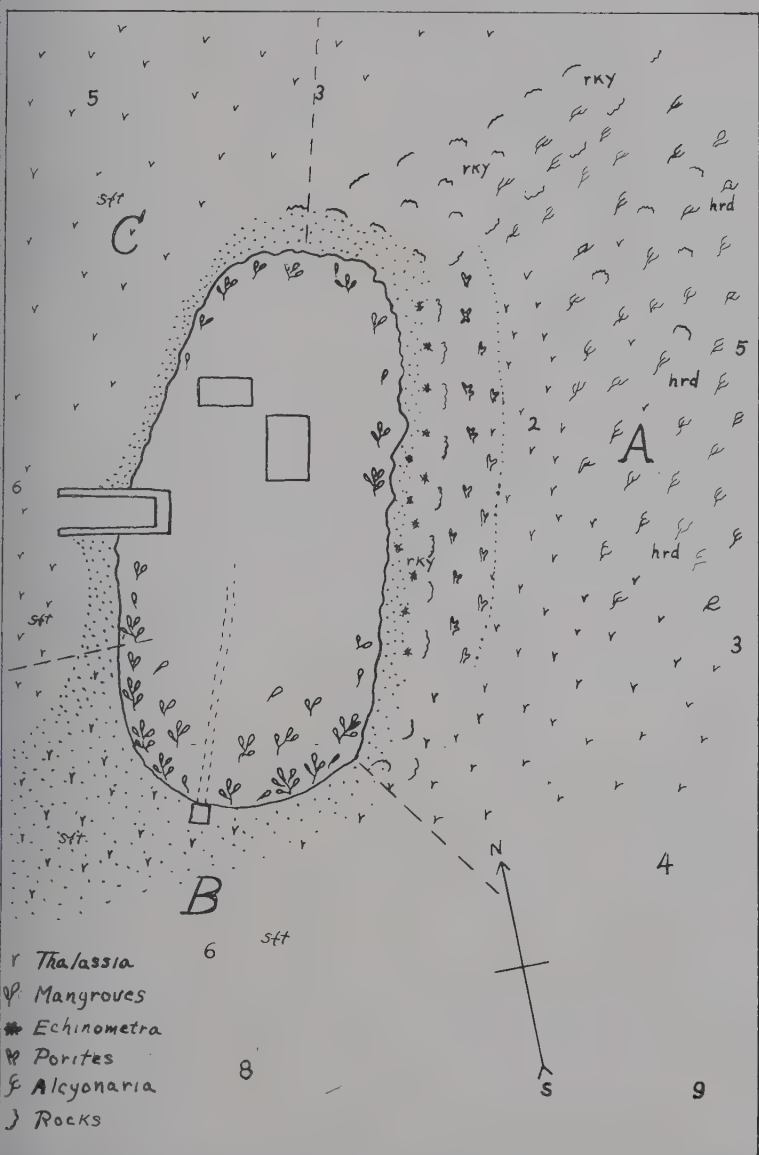


FIGURE 2. Detail map of Soldier Key showing areas A, B, and C and their related zones. Broken lines indicate boundaries of the three areas. Numerals indicate depth in feet at mean low water.

Key it averages about 50 feet) and in some places is lacking, its place being taken by the reef flat. The lower platform may be smooth, eroded, or have strong pinnacles, remnants of the former upper platform, rising from the lower platform base. Most of this zone is covered at low water except at times of extreme low spring tides.

D. Reef flat.

The reef flat extends from the lower platform to seaward and is typically covered by *Thalassia* interspersed with patches of rock, small sandy areas, and mud. It may be very shallow for many yards off shore, forming extensive exposed banks at extremely low spring tides, or it may shelf rather rapidly into deep water.

Ecological areas.

Area A.

For the purpose of our study we are dividing Soldier Key into three ecological areas as shown in Figure 2, characterized by different wave exposure, type of bottom or partial stagnation. Area A extends from the north end of the island around the east side southward to the mangrove fringe. This is the exposed ocean side of the key. On the north end of this area the deeper water approaches the shoreline which here is rather abrupt. On the south end the shoreline is obscured by mangroves and is marked by the beginning of an extensive sandy area. The water is more nearly open coastal water and there is little sedimentation.

Area B.

This area occupies the southern and southwestern end of the key and is plainly demarcated landward by a strong growth of mangroves and seaward by shallow flats of sandy mud, covered by *Thalassia*. Most of this area is exposed at extreme low water. It is cut off from the more extensive beds southward by deep channels caused by the scouring action of the tidal currents. The water here is mixed coastal and bay water and there is heavy sedimentation.

Area C.

Area C extends from the north end of the key to the mangroves at the south end and lies predominantly on the western or bay side of the key. Although the water deepens much more precipitously in this area, the shore is composed of broken rock and shingle and is characterized by conditions of stagnation and general dearth of most kinds of life with the exception of *Thalassia*. In this area there is little exchange of seawater due to the interference of the surrounding shoals

and the deep pocket in the natural turning basin at the entrance to the boat slip.

LIFE OF THE INTERTIDAL ZONE

The intertidal zone consists of the upper platform, the platform face and the pinnacles of the lower platform. Although, as previously stated, the lower platform is occasionally bared at extreme low water, it is part of the shallow water habitat.

Area A.

The most common animals of this area in the intertidal zone are the ribbed barnacle, *Tetraclita squamosa stalactifera*, the common chiton, *Acanthopleura granulata*, and the sea roach, *Ligia baudiniana*. At low water large numbers of the black sea slug, *Onchidium* sp., are found crawling about among the rocks in the lower part of the intertidal zone.

Tetraclita is the commonest genus of barnacles at Soldier Key. It is found from about 6 inches above mean low water to the upper platform edge and shoreward for about two feet, its vertical range limited by the mean high water mark. This species is found throughout the keys, but is less common in the mainland areas north of Miami. The small grapsoid crab, *Pachygrapsus transversus*, is common beneath loose rock at the mean low water level and below.

Characteristic of area A are forms which need a plentiful supply of clear coastal water or live within the splash zone. The matted zoantharians, *Zoanthus pulchellus* and *Z. sociatus*, are commonly found below the mean low water level, but in areas of erosion the mats invade the intertidal area. *Zoanthus pulchellus* was found at Soldier Key to a height of 4 inches above mean low water whereas *Z. sociatus* occurred only to a height of 2 inches above mean low water. The same species may invade this zone to a much greater height, living in small pools of water trapped in the eroded limestone. Living with them in the pools are occasional specimens of the giant anemone, *Condylactis gigantea*.

In the spray zone both *Acanthopleura granulata* and the gastropod, *Nerita fulgurans*, are common. The Stephensons reported *Tectarius muricatus* from the splash zone at Soldier Key, but in repeated visits to the key we were unable to find this species represented except once at the boatslip.

At about mean high water considerable numbers of the bivalve, *Isognomon semiaurita*, are found clinging in small patches to the sides

of crevices and erosion holes. This mollusk is common in the keys but is replaced to the northward by the larger *Isognomon alata*.

The commonest alga in the intertidal zone is *Bostrychia tenella*, which, in conjunction with other species, forms a typical black moss-like growth scattered over the surface of the rocks from the yellow zone into the black zone and farther up the shore. This moss forms a considerable part of the food of some of the browsing mollusks such as *Siphonaria pectinata* which is found in limited numbers, and perhaps also of *Nerita fulgurans*.

The rocks throughout the intertidal area are honeycombed by sipunculids of the genera *Phascolosoma*, *Physcosoma* and *Aspidosiphon*, while the rocks at the lower level are extensively bored by the sponge *Cliona*. Less numerous was the boring barnacle, *Lithotrya dorsalis*, a much more prominent member of the rock boring community in the West Indian faunal area than hitherto supposed.

Area B.

Little intertidal life is found in this area. It is perhaps best characterized by the heavy growth of the alga *Bostrychia tenella* matting the mangrove roots, and accompanied by the oyster, *Pinctada radiata*. This algal mat is restricted to the area between mean low water and mean high water. High up in the mangroves and well above the spray zone are the characteristic mangrove snails, *Littorina angulifera*. Although rocks are present in this area they have been overgrown and covered by the mangroves whose roots present the only surface exposed to the open water.

Area C.

The shore in this area is composed of broken loose rock and shingle which offers little security for intertidal animals. The exception to this is the cement jetties protecting the boat slip about midway of the island. On the sides of the boat slip were numerous *Ligia baudiniana* and *L. exotica* and the only extensive colonies of the limpet, *Siphonaria pectinata*, the latter living at or just below the high water mark. The occurrence of this extensive colony of *Siphonaria* on the bay side of the island does not agree with the statement by the Stephensons that they found this species only on the oceanic side of the keys.

Within the slip numerous colonies of the bivalve *Isognomon alata* occur. *Pachygrapsus transversus*, the small grapsoid crab, occurs in moderate numbers beneath the rocks. Only on the sides of the boat slip did we find *Littorina ziczac* and *Tectarius muricatus*, scattered above the high water mark. On the outside of the boat slip were

Nerita fulgurans, *N. tessellata*, and *N. versicolor*. These were scattered throughout the intertidal area.

Beneath the rocks in this area was the grapsoid crab, *Pachygrapsus transversus*, and boring into the platform face were numerous sipunculids. Near the north end of area C, where the platform face is again distinct, numbers of the boring barnacle, *Lithotrya dorsalis*, were found. Scattered *Tetraclita* and the chiton, *Acanthopleura*, also are found but not in the quantities present on the ocean side.

LIFE OF THE SHALLOW WATER

The term shallow water is here employed for the combined lower platform and reef flat. It thus extends from the mean low water level outwards to a depth of about eight feet (see Figure 3). Within this area certain animal and plant communities form such characteristic zones that we propose to call these by the name of the most common animals and plants found within them. In the following discussions we propose to take in turn the various ecological areas designated previously as A, B, and C and describe the zones as they are encountered proceeding seaward from the platform face.

AREA A

Echinometra zone.

Between the platform face and the end of the lower platform the bottom is pitted and eroded forming many holes and crevices in the rock. At Soldier Key this area is inhabited mainly by the West Indian sea urchin, *Echinometra lucunter*, which forms a prominent character of many similar areas in the Florida Keys and extends seaward to a depth of about 1½ feet. This urchin is reported to assist in the erosion of the holes by clearing the surface of the rock allowing stronger corrosive action by the sea water. Accompanying it is the starfish, *Echinaster sentus*, probably one of the commonest species in the West Indian area. Occasionally *Linckia guildingi* is found but its presence in this zone is probably fortuitous.

Beneath the broken rocks in this area few animals are found. Hermit crabs occupying old mollusk shells and a few living gastropods such as *Cantharus tinctus* are nearly the sole representatives. Exposed in tide pools and in somewhat protected areas are occasional specimens of the anemone, *Condylactis gigantea*.

Porites-coralline zone.

One of the most conspicuous features of the eastern shoreline of

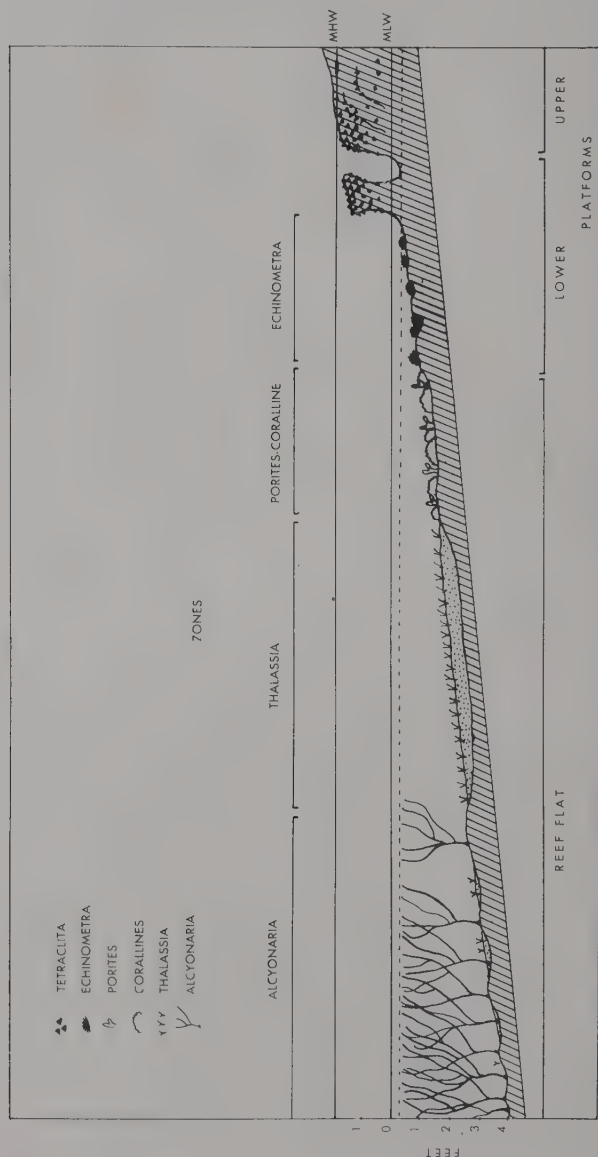


FIGURE 3. A diagrammatic transect seaward from the upper platform to a depth of 4 feet below mean low water (not drawn to scale). The slanting lines represent the solid rocky base, the stippled lines represent calcareous sands and mud. The horizontal broken line represents the level of mean low water springs. The horizontal distance shown is about 300 feet.

Soldier Key is the rather dense growth of the coralline algae composed of low beds of the unattached forms such as *Janea*, *Amphiroa*, and *Goniolithon*, intermixed with low, scattered growths of the coral, *Porites furcata*. This we propose to call the *Porites*-coralline zone. It is not continuous and is often interrupted by beds of the marine "grasses": *Thalassia testudinum*, the turtle grass, and *Cymodocea manatorum*, the manatee grass. Certain of the green algae such as *Penicillum* and *Halimeda* are also found growing in clear areas of this zone.

Farther from shore, in the midst of this zone, little else is found with the exception of small areas of the alga *Laurencia*. Occasional specimens of the pink conch, *Strombus gigas*, are found, but these apparently are seasonal unless they are now making a comeback after a long period of near extinction in the Florida Keys. We observed them again in good numbers for the first time in March of 1953.

The *Porites*-coralline zone extends outward from the shore for a distance of about 50 feet and a depth of from one to two feet. Beyond this it is replaced by the following zone.

Thalassia zone (Turtle grass zone).

Extending outwards from the edge of the *Porites*-coralline zone and at a slightly lower level, continually deepening on a slight gradient, is an extensive area characterized by broad beds of *Thalassia testudinum*. This area varies from about 100-150 feet in width and is fairly smooth with occasional depressions of clear patches of sandy mud. Other than the *Thalassia* the commonest organisms found in this area are the sponges.

In the shallower inshore waters are numerous bunches of a yellowish-brown branching sponge, *Anthosigmella*. These bunches are lightly attached to the bottom and form curious sprawling clumps. Beyond these to seaward occur the numerous and easily distinguished common sponges of the Florida coast, the loggerhead sponge, *Spherospongia vesparia*. These are flat-topped black or dark grey sponges with a shallow cavity in the center. Much work has been done by Pearse (1932) and others on the animals found within the water canals of this sponge and we do not propose to list these organisms in this study.

Two other sponges are commonly found in this area, *Geodia gibberosa* and *Haliclona rubens*. *Haliclona rubens*, the red sponge, is common on the northern end on a rocky substrate. In the other part

of the *Thalassia* zone the vase sponge, *Spongia graminea*, is not uncommon.

This area is not very rich in the larger animal forms. Besides the sponges, echinoderms are most numerous. Holothurians are represented by *Holothuria floridana* and *Actinopyga agassizi* with its commensal fish *Fierasfer*. The common West Indian sea biscuit, *Clypeaster rosaceus*, is abundant. Two urchins, *Lytechinus variegatus* and *Triplaneustes esculentus* the sea egg, take the place of the inshore *Echinometra*. The former species habitually holds pieces of leaves, broken shell and grass over the test either for disguise or protection from the strong illumination in the shallow water. Very rarely the giant cushion star, *Oreaster reticulatus*, wanders in from the deeper waters off shore.

In the northern end a few alcyonarians, *Pterogorgia citrina* and *P. anceps*, are occasionally found, but in general this group is lacking. Mollusks are rather poorly represented with the exception of *Vasum*, *Fasciolaria* and *Strombus*. We have found *Fasciolaria gigantea* (*Pleuroploca gigantea*) on several occasions feeding upon large *Strombus* and one individual spawning in April.

Corals are not numerous but *Siderastraea*, *Diploria*, and *Porites porites* are found. Smaller life in general is lacking due to insufficient shelter with the exception of young *Astraea longispina* and *Turbo castaneus* which are found growing on the *Thalassia*. Scattered coral heads, washed ashore by severe storms, give shelter to a few mollusks such as *Cantharus*, *Pyrene rusticoides*, *Thais*, *Leucozonia*, *Lima*, *Pecten* and some others, and to the common bristle worm, *Hermodice carunculata*. Crustacea are represented by the stomatopod, *Gonodactylus oerstedii*, young crawfish, *Panulirus argus*, and the masking crabs *Macrocoeloma* and *Microphrys*.

Alcyonaria zone.

Extending outwards from the *Thalassia* zone at a depth of about two feet is a broad and luxuriant growth of alcyonarians. This is one of the most characteristic features of the West Indian and Floridan shallow waters (Bayer, 1953). Nowhere else in the world have the alcyonarians developed with such diversity and numbers as in the Western Atlantic. Soldier Key represents one of the northernmost extensions of the shallow water alcyonarian zones and is thus important ecologically in this and future discussions of other areas similarly treated.

The alcyonarians are at first rather sparse, but after a few feet they become a significant feature of the life. Most characteristic are

the plume-like *Antillogorgia acerosa* and *A. americana*. These form colonies of considerable size, attaining 3½ to 4 feet in height although most of them are low bushy forms. *Plexaura vermiculata* is also common, the expanded polyps being very prominent features of the living colony. *Eunicea calyculata* and *Plexaurella* spp. form the major constituents of the zone in common with those mentioned above.

On the dead skeletons of the alcyonarians the stinging coral, *Millepora alcicornis*, is commonly found, assuming a lacy appearance due to the substrate. We have never found the more typical plate-like form in this area but it is common on the outer reefs farther off shore.

Three genera of mollusks seem to be closely related to certain of the alcyonaria. The bivalve *Pteria* is usually found attached to the skeleton of living or dead *Antillogorgia* and is seldom found otherwise. The relationship of the gastropods *Cyphoma* and *Simnia* to the alcyonaria is as yet unexplained and we cannot state whether they are commensals or parasites. *Cyphoma* lives mainly upon *Antillogorgia* colonies. During calm weather they crawl freely about upon the branches of the colony, but during periods of wave action they cluster together at the base of the colony where they are less disturbed by the swaying of the alcyonarian. *Simnia*, a delicate thin-shelled mollusk, dwells mainly on *Gorgonia flabellum* which is absent at Soldier Key. During life its small size and adaptive coloration make it nearly invisible but they may be easily collected after the colony has been dried.

At Soldier Key a very important feature of this zone is the large number of basket starfish, *Astrophyton muricatum*, found entwined in the branches of the *Antillogorgia*. In the late spring and early summer nearly every colony supports at least one of these in its branches and we have seen as many as ten individuals in a single colony of *Antillogorgia*. It has been supposed that this brittlestar feeds upon the polyps of the alcyonarian, but this has not been demonstrated to our knowledge.

Life in the open alcyonarian zone is conspicuous by its sparsity, with the exception of the always present small coral fish. Scattered *Thalassia* is found in the thin layer of sand covering the limestone substrate. Large broken coral fragments from offshore growths of *Acropora palmata* are not infrequent, and these offer shelter to many species of mollusks. Characteristic of these coral fragments are the tube worms *Pomatoceros* and *Pomatostegus* whose brilliantly colored tentacles are very conspicuous. The corals also afford shelter for large

numbers of crawfish, *Panulirus argus*, often a dozen or more under one fragment, and also affords a secure retreat for the common *Ocypode briareus*. Eggs guarded by the female are frequently found in such places in January and February. The file shell, *Lima*, and a tube-dwelling worm, *Amphitrite*, are also common, along with the securely attached tunicate, *Polycarpa obtecta*. Burrowing in the dead coral are small numbers of the date shell, *Lithophaga*, always prominent in corals of tropical areas. Beneath the coral slabs and wedged beneath the edges are the long spined black sea urchins, *Diadema antillarum*. Other echinoderms found lying in the turtle grass are *Actinopyga* and *Clathropaster*.

A rather specialized zone or subzone of area A is found at the northeast corner of the island where a rocky point is swept by swift moving tidal currents. Growing on the surface of the rocks is a *Pleurogorgia aurella* and small growths of *Pterogorgia*. The rocky ridge has a great deal of broken rock inhabited mostly by small moray eels which make further detailed study somewhat unattractive.

AREA B

This area presents a uniform habitat extending from the southeast corner of the island out to the edge of a small channel about 10-15 feet deep which runs by the island in a northeast-southwest direction. At the end of the island the channel is close, about 150 feet distant but as it angles away, it leaves a long sand and mud flat which projects outward from the island in a southwesterly direction. This flat is shallow with a very slight gradient and is bared at low spring tide. It is covered with a rather uniform growth of *Thalassia* interspersed with *Halimeda* and small colonies of *Porites furcata*. This area is almost completely devoid of larger forms of marine life, those found usually consisting of the crabs *Callinectes sapidus* and *C. ornatus* and a few bivalve mollusks such as *Codakia* and *Lucina*. Large numbers of a burrowing worm form mammillated mounds over large sections of this flat. Extensive digging by various persons have disclosed no worms but they are presumed to be the mounds of *Arenicola cristatus*. The hydroid *Lytocarpus* is not infrequently attached to submerged objects.

AREA C

This, the inshore or bay side of the island, is a comparatively small area restricted to a bordering strip of shoal extending out from the key about 20-30 feet. The bottom is mud and sand, interspersed

with broken coral rock. Very little algal growth is present, and the animal life is not conspicuous, being restricted to such forms as the gastropod *Cerithium litteratum* which here occurs in large numbers (see Stephensons) along with thousands of small shells occupied by hermit crabs. The brachyuran crab *Leptodius floridanus* is found among the rocks. We have occasionally found here living specimens of the rose coral, *Manicina areolata*, a form which is found in areas of strong sedimentation where they are able to live by clearing themselves by the beating of their cilia.

GENERAL DISCUSSION

As has been pointed out by the Stephensons (1950) and others, the southeast coast of Florida is typically West Indian in its marine fauna and flora and is included within this general faunal area. This condition is no doubt due to the warming influence of the waters of the Florida Current.

Perhaps the most obvious observation to be made from the data at hand is the large concentration of life on the offshore or ocean side of the key and the corresponding scarcity of all but a few forms on the Biscayne Bay side. This was noted by the Stephensons as a general condition found throughout the keys especially in those bordering upon Florida Bay. The similarity between the two bodies of water is to be deduced from our observations, but in general much higher salinities and ranges of temperatures are to be found in the Florida Bay area due to the greater extent of extremely shallow water, averaging only one or two feet in depth. Despite these general conclusions it must be pointed out that certain individual species such as *Batillaria minima*, *Thalassia*, and a few others are found in great numbers locally in the Bay side.

Probably the greatest hindrance to life in the keys is the extremely large amount of sedimentation which goes on continually throughout these shallow water areas. In some localities this sedimentation of very fine loose, grayish calcium carbonate deposition may reach a depth of several feet, effectually smothering almost all forms of bottom life. During periods of calm weather the coastal and inshore waters of the Florida Keys are noted for their clarity. Bottom life can often be observed easily in depths of 50-60 feet and over. However, during periods of stormy weather the bottom depositions may become so disturbed by wave action as to turn the water milky and practically prohibit light penetration.

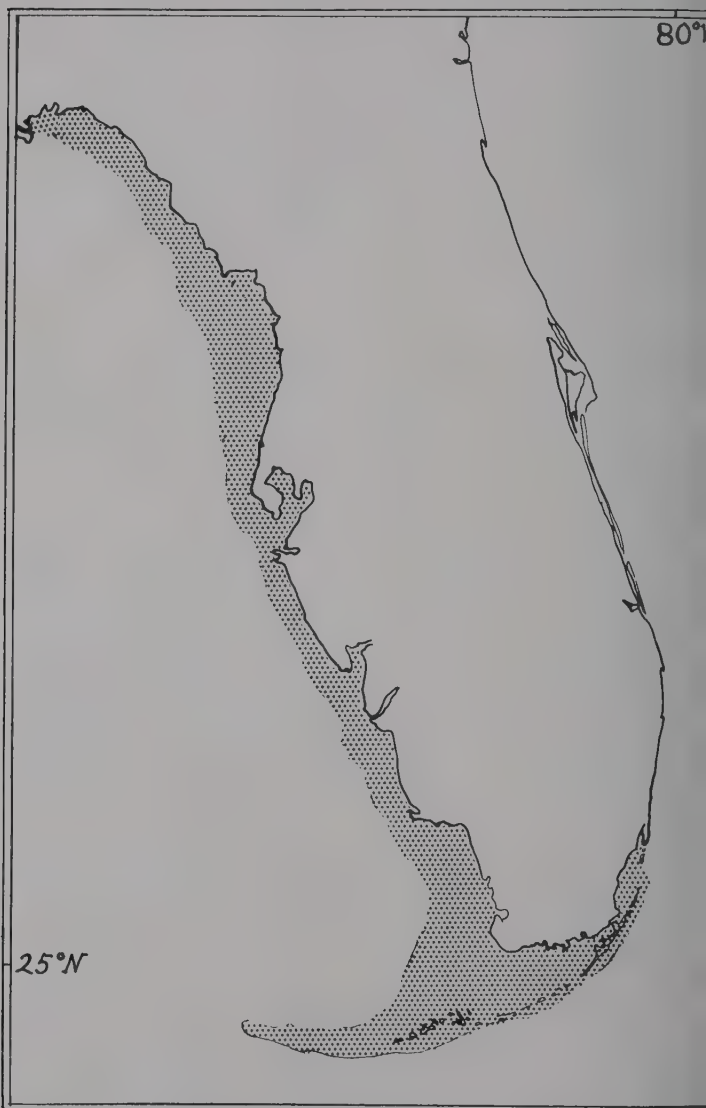


FIGURE 4. A map of peninsular Florida showing the distribution of *Thalassia testudinum* (stippled area). It is probable that the *Thalassia* beds extend even farther off shore in the Gulf area than is indicated here.

Under such conditions few marine organisms can exist. Marine plants of all but the rhizoidous groups and epiphytes are completely eliminated. Such forms as *Thalassia*, *Caulerpa*, *Halodule*, and similar marine plants maintain themselves in this habitat by the formation of extensive rhizoidal net works which, in effect, form their own substrate.

The *Porites*-coralline zone is of constantly recurring nature in many places in the Florida Keys, but it is not known north of Miami. In some of the keys this zone is not found, its place being taken over immediately at the foot of the upper platform by the *Thalassia* zone. A few words about *Thalassia* seem pertinent here. In their discussion of the Florida Keys the Stephensons note the paucity of organic production in the intertidal and shallow water of Florida due to an apparent paucity of nutrient rich waters and the presence of heavy sedimentation. The authors feel that this is not justified except in the intertidal zone. In the shallow waters of south Florida the most conspicuous feature is the extensive and almost universal occurrence of the *Thalassia* beds. The turtle grass first occurs in beds in south Florida in the Biscayne Bay region where it occurs from the vicinity of Miami River, and the north end of the Bay, stretching southwards and westward to Dry Tortugas, in almost unbroken dense matted beds. It forms a nearly complete cover for the bottom of Biscayne Bay and Florida Bay from the mainland to the keys and offshore to the outer reef where it ceases in the coral zone. From the Cape Sable region to the southern tip of the mainland (Figure 4) it stretches off shore as a nearly continuous bed from there to the northern Gulf region, sometimes, as in the vicinity of St. Martins Reef (north of Tarpon Springs on the Gulf coast), extending from the shore outwards to a distance of over 18 miles. In depth it ranges from shallow banks which are bared at low tide to a depth of around thirty or forty feet. This vast and impressive quantity cannot be overlooked in the question of organic production. Tons of dead turtle grass are washed ashore each day along the Florida coast yet no apparent reduction in the beds is visible. A study of the growth rate and consequent production of the beds would be of great value together with a study of the vertebrate life peculiar to this habitat.

It is true that *Thalassia*, which grows only to a height of perhaps 18 inches, is not as striking as such northern sea weeds as *Laminaria* and *Fucus*, but the more extensive distribution would seem to outweigh this consideration. We feel that more attention should be

centered upon the importance of the turtle grass in southern waters.

The alcyonarians of Florida and the West Indies have long been a source of observations and mention by many authors. In the West Indian region, in contrast to the Pacific areas, the alcyonarians are noticeable and important constituent of the shallow water areas. Despite their prevalence and general interest little has been done on their zoogeography within the West Indies themselves until Bayle (1953) studied their distribution.

Although the concentrations of alcyonarians at Soldier Key are striking and important there are several areas among the keys where these organisms grow in much more luxuriant beds. Among these must especially be noted Broad Creek between Old Rhodes and Palmetto Alto Keys and East Sister Key off Marathon. At Broad Creek they grow on a clean substrate of limestone which is smooth and mammillated. The colonies are rank, tall and bushy, and at low tide they reach the surface where they lie over with the tidal current. They are always found firmly attached to a hard, usually rocky, substrate.

Although no attempt is made in the present paper to discuss the distribution of the animals and plants mentioned, one gorgonid, *Gorgonia flabellum*, is worthy of mention. At Soldier Key this common sea fan is entirely lacking, for no apparent reason, although it occurs directly off shore three miles away at Fowey Rocks and is common on the outer or barrier reef and on the lagoon or pseudo-lagoon (Hawk Channel) coral pinnacles such as at Bache Shoal about ten miles distant. It may be that this species requires more open ocean water than the others and is less capable of withstanding sedimentation.

The authors purposely are refraining in this paper from attempting to make comparisons or draw general conclusions concerning apparent or existing similarities or contrasts between Soldier Key and other areas. At the present writing too little is known concerning the distribution or occurrence of marine organisms in other areas of Florida.

LIST OF FAUNA AND FLORA

The following list of plants and animals from Soldier Key is of necessity incomplete due to lack of collecting data and difficulty of collection and identification of many of the smaller and lesser known marine organisms. For the greater part the identities of the organisms listed are the work of the authors and discrepancies or erroneous identifications are our responsibility. Although incomplete we feel

that the groups covered are more or less characteristic and will be of value to future workers, both zoogeographers and ecologists, in the south Florida region.

PORIFERA

- Leopetrosia longleyi*, area A, *Thalassia* zone, in clumps.
Anthosigmella sp., area A, *Thalassia* zone in clumps.
Arinia campana, area A, alcyonaria zone, on coral rock.
Arinia strobilina, area A, alcyonaria zone, on coral rock.
Phaciospongia vesparia, area A, *Thalassia* and alcyonaria zones, numerous in former.
Maliclonia rubens, the red sponge found in area on rocks at northern point.
Sysidea etherea, area A, *Thalassia* zone, attached to rock fragments.
Serongia fistularis, area A, *Thalassia* zone, uncommon.
Spongia graminea, area A, *Thalassia* and alcyonaria zones, common, growing to large size.
Ecthyra sp., areas A, B, and C, growing under rock fragments, not common.

CNIDARIA

HYDROIDS

- Hydrocarpus filippinus*, area B, on grass flat.
Hydrillepora alicornis, area A, alcyonaria zone, encrusting on dead alcyonarian skeletons.

SEA FEATHERS AND WHIPS

- Hydrilloporia acerosa*, area A, alcyonaria zone, one of the most prominent purple alcyonarians.
Hydrilloporia americana, area A, alcyonaria zone, forming large colonies.
Hydrilloporia anceps, area A, alcyonaria zone, low colonies which are rather common.
Hydrilloporia citrina, area A, alcyonaria zone, forming low sparse colonies on rocks at northeast point.
Hydrilla dichotoma, area A, alcyonaria zone, growing in sparse colonies with stout branches.
Hydrilla vermiculata, area A, alcyonaria zone, this species closely resembles the former with which it is easily confused.
Hydrilla calyculata, area A, alcyonaria zone, fairly common colonies with prominently expanded polyps.

SEA ANEMONES

- Condylactis gigantea*, area A, in all zones, large anemones with purple tipped tentacles.
Actinia annulata, area A and B, *Thalassia* zone, attached to rock and shell fragments, tentacles slender, brownish with annulations.

CORALS

- Porites porites*, areas A and B, *Thalassia* and alcyonaria zones, branches thick, not common.
Porites furcata, areas A, B, and C. *Porites*-coralline zone, small colonies a few inches in height, branches slender and knobbed.
Porites astreoides, area A, *Thalassia* zone, forms heavy, incompletely branched colonies.
Siderastrea siderea, area A, *Thalassia* and *Porites*-coralline zone, not common.

Siderastrea radians, area A, *Thalassia* and *Porites*-coralline zone, forms small round knobs on bottom.

Favia fragum, area A, *Thalassia* zone, small round balls attached to hard base.

Montastrea annularis, area A, alcyonaria zone, not common.

Diploria clivosa, area A, alcyonaria zone, not common.

Manicina areolata, area C, living in sandy areas, when young attached by stalk which later breaks off.

ZOOANTHIDEANS

Zoanthus pulchellus, area A, intertidal and *Echinometra* zone.

Zoanthus sociatus, same.

Palythoa mammilatus, area A, *Echinometra* zone, small thick colonial matts.

ANNELIDA

POLYCHAETES

Amphinome jamaicensis, area A, *Thalassia* zone, under coral fragments, gills reddish.

Hermodice carunculata, area A, *Thalassia* zone, under coral fragments, gills greenish.

Eurythoe complanata, area A, *Thalassia* and alcyonaria zones, under rocks.

Notopygos crinita, area A, *Thalassia* zone, under rocks.

Leodice caribaea, area A, *Thalassia* and alcyonaria zones.

Leodice longicirrata, area A, *Thalassia* and alcyonaria zones.

Leodice longisetis, area A, *Thalassia* and alcyonaria zones.

Leodice rubra, area A, *Thalassia* and alcyonaria zones.

Leodice spongicola, area A, *Thalassia* zone, forming parchment-like tubes in the interior of sponges.

Amphitrete ornatus, area A, *Thalassia* and alcyonaria zones, in soft tubes beneath rocks and coral fragments.

Pomatostegus stellatus, area A, alcyonaria zone, forming calcareous tubes in coral heads, the tentacles extended fan-like.

Pomatoceros oerstedii, area A, alcyonaria zone, found in similar manner to the above.

ECHINODERMATA

SEA URCHINS AND SEA BISCUITS

Diadema antillarum, area A, alcyonaria zone, under rocks, long black spines.

Eucidaris tribuloides, area A, *Thalassia* and alcyonaria zones, primary spines heavy and blunt.

Lytechinus variegatus, area A, *Thalassia* zone, area B, on grass bed, usually covered with leaves and shells.

Tripneustes esculentus, area A, *Thalassia* zone, large, white.

Echinometra lucunter, area A, *Echinometra* zone, dark reddish in holes.

Clypeaster rosaceus, areas A and B, *Thalassia* and alcyonaria zone, the common sea biscuit.

STAR FISHES

Oreaster reticulata, area A, alcyonaria zone, large, reddish or yellow.

Echinaster sentus, area A, *Echinometra*, *Thalassia* and alcyonaria zones, under rocks, reddish, common.

Linckia guildingi, area A, all zones, long armed and hard.

BRITTLE STARS

Astrophyton muricatum, area A, alcyonaria zone, wrapped in sea feathers.

- Amphiura palmeri*, area A, all zones except the *Echinometra* zone.
Ophiothrix oerstedii, area A, all zones except the *Echinometra* zone.
Ophiocoma riisei, area A, all zones except the *Echinometra* zone.
Ophioderma appressum, areas A and B, *Thalassia* and alcyonaria zones, compact, greenish or variegated mottlings.
Ophioderma cinereum, areas A and B, *Thalassia* and alcyonaria zone.
Ophiomyxa flaccida, area A, *Thalassia* and alcyonaria zones, large, cream to brown with soft disk.

SEA CUCUMBERS

- Holothuria floridana*, areas A and B, *Thalassia* and alcyonaria zones.
Actinopyga agassizi, areas A and B, *Thalassia* and alcyonaria zones.

MOLLUSCA

AMPHINEURA

- Amphineura granulata*, areas A and C, above the highwater mark on rocks.
Ischnochiton limaciformis, area A, alcyonaria zone under rocks.

GASTROPODS

- Lucapina suffusa*, area A, *Thalassia* and alcyonaria zones under rocks.
Lucapina sowerbyi, area A, *Thalassia* and alcyonaria zones, under rocks.
Diadora listeri, area A, all zones, under rocks.
Turbo castaneus, areas A, B, C, on *Thalassia*.
Nerita fulgurans, areas A and B, on rocks at about mid-tide mark.
N. versicolor, area C, on boat slip sea wall.
N. tessellata, area C, boat slip sea wall.
Astraea americana, area A, alcyonaria zone.
A. longispina, areas A and B, on *Thalassia*.
Littorina angulifera, areas A, B, C in mangroves above high water.
L. ziczac, area C, boat slip seawall.
Tectarius muricatus, area C, in boat slip on sea wall.
Modulus modulus, all areas, growing on *Thalassia*.
Cerithium literatum, all areas just below low tide mark.
Batillaria minima, area C, just below low tide.
Strombus giagas, area A, *Thalassia* zone.
S. raninus, area A, *Thalassia* zone.
Cyphoma gibbosa, area A, alcyonaria zone living on sea feathers.
C. mcgintyi, same as above.
Simnia uniplicata, area A, alcyonaria zone living on sea feathers.
Cypraea zebra, area A, *Thalassia* and alcyonaria zones under rocks.
Muricidea hexagona, area A, *Thalassia* and alcyonaria zones under rocks.
Thais patula, area A, on rocks at mid tide.
T. rustica, areas A and C, on rocks at mid tide.
Vasum muricatum, area A, in grass.
Pyrene mercatoria, area A, just below low tide mark.
P. rusticoides, area A, alcyonaria zone.
Cantharus tinctus, area A, *Echinometra* zone under rocks.
Pleuroploca gigantea, area A, *Thalassia* and alcyonaria zones, largest of the gastropods in the area.
Fasciolaria tulipa, areas A and B, *Thalassia* and alcyonaria zones.
Fasciolaria distans, areas A and B, in sand and grass.
Latirus mcgintyi, area A, alcyonaria zone under rocks.
Conus mus, area A, under rocks.

Tethys dactylomela, area A, *Thalassia* and alcyonaria zone.
Siphonaria pectinata, area C, boat slip, on sea wall.

PELECYPODES

Arca barbata, areas A and C, in shallow water under rocks.
Atrina rigida, area B, on grass bed.
Pteria colymbus, area A, alcyonaria zone living on sea feathers.
Pinctada radiata, area B, living on *Thalassia*.
Isognomon alata, area C, in boat slip.
Isognomon semiaurita, areas A and C, on rocks intertidally.
Pecten sentis, area A, *Thalassia* and alcyonaria zone under rocks.
P. antillarum, areas A and B, in clumps of *Porites*.
Lima scabra, area A, alcyonaria zone in holes in rocks.
L. tenera, area A, alcyonaria zone in holes in rocks.
Lithophaga antillarum, area A, alcyonaria zone, burrowing in rocks.
Lucina pensylvanica, areas A and B, *Thalassia* zone.
Codakia orbicularis, area A, *Thalassia* zone.

CEPHALOPODA

Octopus briareus, area A, alcyonaria zone under rock.
O. vulgaris, area A, alcyonaria zone under rocks.
O. joubini, area A, *Thalassia* zone in shells of *Codakia*.

ARTHROPODA

CIRRIPIEDIA

Tetraclita squamosa stalactifera, areas A, B, C, on rocks along the shore.
Lepas anatifera, all areas on drift wood.
Lithotrya dorsalis, north end of areas A and B in intertidal rocks.

ISOPODA

Ligia baudiniana, areas A and C, on rocks above high tide.
L. exotica, area C, at boat slip on sea wall.
Exocorallana antillensis, area A, under rocks at mid tide.

MACRURA

Panulirus argus, area A, alcyonaria zone, under rocks.
Tozeuma carolinensis, area A, under rocks.

ANOMURA

Dardanus venosus, areas A, B, C, in gastropod shells.
Pagurus annulipes, areas A and C, in gastropod shells.

GRAPSOID CRABS

Pachygrapsus transversus, areas A, B, C, under rocks along the shore.
Dissodactylus calmani, area C, under rocks near shore.

SPIDER CRABS

Mithrax spinosissimus, area A, *Thalassia* and alcyonaria zones.
M. coryphe, areas A and B, *Thalassia* and alcyonaria zones.
Macrocoeloma trispinosum nodipes, all areas, in grass.
Microphrys bicornutus, all areas in grass.

CANCROID CRABS

Callinectes sapidus, areas A and B, in sandy areas.
C. ornatus, same as above.
Pilumnus caribaeus, areas A, under rocks.

P. dasypodus, areas ? under rocks.
P. diomedae, areas ? under rocks.
P. gemmatus, areas ? under rocks.
Leptodius floridanus, area C, under rocks.
Glyptoxanthus erosus, area A, alcyonaria zone, under rocks.

STOMATOPODS

Gonodactylus oerstedii, area A, all zones, under rocks.

TUNICATA

Polycarpa obtecta, area A, all zones except *Echinometra*.

ALGAE

GREENS

Batophora Oerstedii, areas A, B, and C, growing on shells and rocks.
Dasycladus vermicularis, areas A, B, and C, same as above.
Neomeris annulata, areas A and B, attached to shells and rocks.
Cladophoropsis macromeres, just below low tide mark in all areas.
Dictyosphaeria cavernosa, areas A and B.
Valonia ventricosa, area A, *Porites*-coralline zone and seaward.
Caulerpa cupressoides, all areas.
C. lanuginosa, area B.
C. paspaloides, areas A and B.
C. prolifera, areas A and B.
C. racemosa, area A, north end on rocky point.
C. sertuloides, areas A and B.
Halimeda discoides, areas A and B.
H. monile, areas A and B.
H. opuntia, all areas.
H. scabra, area ?
H. tridens, areas A and B.
Penicillus capitatus, areas A, B, and C.
P. dumetosus, areas A, B, and C.
Rhipocephalus oblongus, all areas.
Udotea conglutinata, all areas.
U. flabellum, all areas.

BROWNS

Dictyota Bartayresii, area A, *Thalassia* zone and seaward.
D. dichotoma, area A, *Thalassia* zone and seaward.
D. divaricata, area A, same as above.
D. indica, area ?
Padina Sanctae-Crucis, area A, *Thalassia* zone and seaward.
Sargassum polyceratum, area A, alcyonaria zone.

REDS

Janea sp. area A, in *Porites*-coralline zone.
Amphiroa sp. area A, in *Porites*-coralline zone.
Goniolithon sp. area A, in *Porites*-coralline zone.
Laurencis poitei, area A, same as above and seaward.
Bostrychia tenella, all areas in intertidal zone.

MARINE GRASSES

Thalassia testudinum, all areas, and scattered in almost all zones.
Cymodocea manatorum, scattered in all areas.
Halodule Wrightii, scattered in all areas.

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DISTRIBUTION OF THE LONGSPINED PORGY, *STENOTOMUS CAPRINUS*

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ABSTRACT

The geographic distribution of the Longspined Porgy, *Stenotomus caprinus*, primarily based on the catch records of the United States Fish and Wildlife Service M/V OREGON, is discussed. This species is apparently limited to the continental shelf in depths of 3 or more fathoms. Its distribution in relation to bottom type is examined and this factor is shown to be a probable limiting effect in determining its distribution. Present evidence indicates that temperature is not an important limiting factor. In general, larger sized individuals are found in deeper water. Its possible occurrence outside the Gulf of Mexico is noted. The systematic status of the species is outlined.

SYSTEMATIC STATUS

This member of the family Sparidae was originally described by Bean (*in* Goode and Bean, 1882:426) as *Stenotomus caprinus*. Jordan and Gilbert (1882:929) then included it in the genus *Argyrops*. Following this, Jordan and Evermann (1896:388) placed it in the separate genus *Otrynter*, which was later diagnosed by these same authors (Jordan and Evermann, 1898:1344). In using the genus *Stenotomus* in this paper, its latest reviser (Ginsburg, 1952:100) is followed.

INTRODUCTION

Through the kindness of Mr. Stewart Springer, Chief of the United States Fish and Wildlife Service's Gulf Fisheries Exploration and Gear Research program, the opportunity was offered to compile the catch records for the Longspined Porgy, *Stenotomus caprinus*, taken by the M/V OREGON in the Gulf of Mexico, and to present the accompanying data on the distribution of this species. The study is based on 692 shrimp-trawl drags made over a four-year period (May, 1950, to June, 1954) in depths of 2 to 930 fathoms. However, only those OREGON drags made in depths of 100 fathoms or less are considered below, since this is apparently the deepest record for this species. Of 576 such drags, 244 yielded *S. caprinus*. All of the OREGON collections of this species were made with the trawl except one, a hand-line catch off the northwest Florida coast in 45 fathoms. For

the purposes of this paper, the terms "successful drag" or "unsuccessful drag" refer only to the success or failure in obtaining *S. caprinus*.

GEOGRAPHICAL DISTRIBUTION AND GENERAL ABUNDANCE

S. caprinus was for years known only as a rare species from very scattered records from deep water in the northern Gulf of Mexico, the species having originally been described from specimens obtained in snapper stomachs from the Pensacola snapper banks. However, Mr. Springer and Mr. Harvey R. Bullis, also of the Gulf Fisheries Exploration program staff, both state (personal conversation) that they consider this to be the most abundant bottom species in the 20-50 fathom range over much of the northern and western Gulf. Siebenaler (1952) notes that it dominates the catch in the 21-50 fathom range off the Mississippi coast. Personal experience on the OREGON in June, 1954, indicates that it is extremely abundant in these depths off the south Texas coast, as well as off the Mississippi River Delta. Hildebrand (1954: 308) notes that this is one of the most common species on the brown shrimp grounds in the western Gulf (concentrated from 12-55 fathoms, depending on the locality), though he states that abundance varies somewhat during different seasons in certain localities off the Texas coast. It is recorded by Springer and Bullis (1952) as the dominant organism in many trawl hauls, particularly off the Mississippi and Alabama coasts, but also off the Louisiana and northeast Texas coast and on the Campeche Bank, in depths of 10-64 fathoms. This was also found to be the case in two hauls observed while on the OREGON off the south Texas coast. Siebenaler (*loc. cit.*) and Springer and Bullis (*loc. cit.*) refer to this species only as "porgies", but these authors state (personal conversation) that the species involved is *S. caprinus*. As may be seen in Figure 1, its distribution is much more widespread than formerly believed.

Gunter and Knapp (1951: 137) record this species from "within 60 miles of Mexico" on the Texas coast and state that this extends its westward range 300-400 miles. The southernmost OREGON record for the extreme western part of the Gulf is off the Mexican coast at 23°21.5' N., 97°29.5' W. Hildebrand (*loc. cit.*) records *S. caprinus* from the 24-10 shrimp grounds (off the Mexican Laguna Madre) but he does not give a definite position for the most southern record along this coast. His records and the above OREGON record



FIGURE 1. Distribution of *Stenotomus caprinus*. (●) indicates one or more successful trawl hauls. (▲) indicates one or more unsuccessful trawl hauls outside the known range of this species.

thus extend the range approximately 225 miles along the western Gulf coast. Though Hildebrand (*loc. cit.*) records this species from the Obregon shrimp grounds (off Obregon, Mexico, in the southern Gulf of Campeche), the OREGON records are apparently the first from the northern part of the Campeche Bank, and the extremes reported below are the first definite points cited for the Campeche area. The most eastern record on the Campeche Bank is at $22^{\circ}27' \text{ N.}$, $89^{\circ}59' \text{ W.}$, the southwestern extreme being at $18^{\circ}45' \text{ N.}$, $93^{\circ}20' \text{ W.}$ The eastern end of the range, off Florida (a line bearing 56° between $28^{\circ}49' \text{ N.}$, $85^{\circ}12' \text{ W.}$, and $29^{\circ}12' \text{ N.}$, $84^{\circ}33' \text{ W.}$), apparently extends the range in that direction, the species previously having been reported from only as far east as the Pensacola snapper banks.

The gap in the range in the southwestern Gulf of Campeche (Figure 1) is almost certainly due to incomplete collecting. The ORE-

GON has made only two trawling stations in this area in less than 100 fathoms. More stations have been made on the Campeche Bank off the northern end of Yucatan east of the known range, but not enough to draw more than tentative conclusions as to the occurrence of this species there. It is possible that this species may occur as far east as the northeastern tip of the Yucatan peninsula, though this is not necessarily so, as will be noted below. The proximity of the 100 fathom curve south of this point, coupled with the northward flow of the Gulfstream, probably acts as a barrier to the occurrence of this species south of here. Figures 1 and 2 show the distribution of OREGON drags off the Florida west coast south of the known range of *S. caprinus*. It will be seen that while collections were made in only five months, both major seasons (summer and winter) are covered, as is the depth of greatest abundance (determined from collections within its known range). This seems to indicate that, on the basis of the OREGON collections, this species does not occur off the Florida coast south of the aforementioned bearing extending into Apalachee Bay. A possible explanation for this distribution will be discussed below. Future collections may make southward extensions of this range, but present evidence indicates that such extension will be based on stragglers rather than on permanent populations.

DEPTH DISTRIBUTION

The shallowest OREGON record for this species is 5 fathoms, while the deepest is 80 fathoms. The aforementioned 100-fathom record is based on material in the Chicago Natural History Museum collected in July, 1952, by J. L. Baughman off the middle Texas coast. Gratitude is expressed to Mr. Loren P. Woods, Curator of Fishes at Chicago, for permission to examine this and other *S. caprinus* in that collection. While in the company of Mr. J. B. Siebenaler on December 11, 1954, a trawl collection was made in 3 fathoms in Choctawhatchee Bay (East Pass), Florida, which included *S. caprinus*. These, and other specimens collected by Mr. Siebenaler in this bay, are apparently the only records for this species from semi-enclosed waters.

Figure 3 gives the distribution of the successful OREGON drags by month and depth. The unsuccessful drags made within the known range are also shown. It will be seen that many gaps in the known depth and/or seasonal occurrence of *S. caprinus* are due to inadequate collecting. It should be pointed out that all drags made under

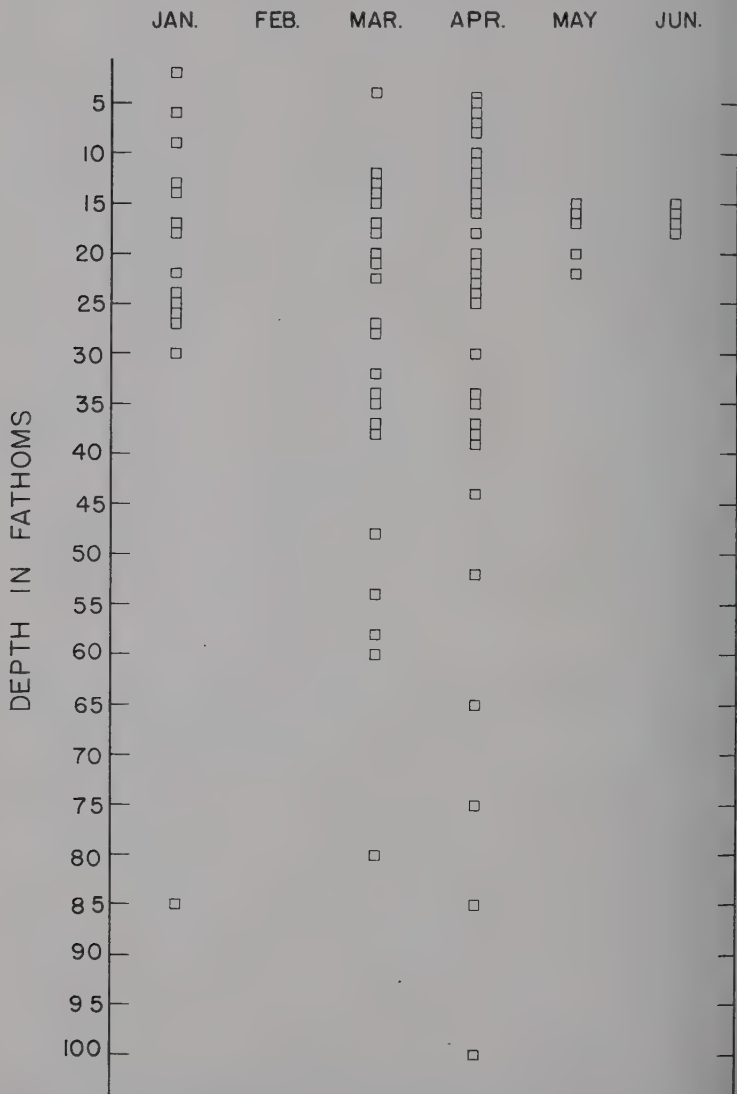


FIGURE 2. Monthly distribution by depth of trawl stations made from May, 1950, to June, 1954, by the M/V OREGON off the west coast of Florida south of the known range of *Stenotomus caprinus*. Each square represents one or more hauls.

what seem suitable conditions do not yield this species. There are a number of cases in which two apparently identical types of drags were made at the same position within a matter of minutes, one yielding *S. caprinus* and the other not. Thus, if another drag had been made at any position indicated in Figure 3 as unsuccessful, it may have shown that *S. caprinus* actually occurred there at that time. The results shown in this figure, coupled with my own collecting experiences (and those of others) in shallower water, indicate that this species is limited to depths of at least 3 fathoms and less than 100 fathoms, though depth in itself may not be a limiting agent, but rather, other various unrecorded factors associated with depth. This species seems to occur in greatest abundance, however, in the 10-65 fathom range.

RELATIONSHIP OF DISTRIBUTION TO BOTTOM TYPE

The occurrence of *S. caprinus* is apparently related to the type of bottom. Of the 244 successful drags, 158 were made on a mud bottom, 64 over partial mud, and only 22 on a non-mud bottom. Those drags yielding *S. caprinus* over a non-mud bottom were made near the eastern end of its range from off Mississippi (where it is extremely abundant on a mud bottom and may "spill over" onto a less suitable bottom) to the end of the known range off the northwest coast of Florida, where it is taken with less frequency as related to the total number of drags. Beyond the Florida end of the range the bottom is generally rocky or sandy and it is probably for this reason that this species does not generally occur there. Bottom conditions in the area of the gap in the southwestern Gulf of Campeche are apparently suitable for its occurrence. Mr. Springer has pointed out (personal conversation) that the bottom off the northern end of the Yucatan Peninsula is much like that off the lower Florida west coast, perhaps explaining the absence of this species east of its known occurrence off the northern tip of Yucatan. It is interesting to note that the distribution of this species as shown in Figure 1 agrees quite closely with the distribution of mud or partial mud sediments shown by Lynch (1954: 79) on his map of the sedimentary provinces of the Gulf of Mexico.

Only 14 of the successful drags were made on a reportedly rough bottom, the rest being noted as having been made on a smooth bottom. However, the OREGON operations tend to explore on trawlable bottom suitable for shrimp, and the apparent preference of this

species for smooth bottom may be a result of inadequate trawling on rough bottom. Both rough and smooth bottom were explored in the area outside the known range of the species, but here again preference was given to attempts on smooth bottom.

RELATIONSHIP OF DISTRIBUTION TO BOTTOM TEMPERATURE

Available evidence indicates that this species is not restricted to any particular temperature. The records show that it has been collected in areas with a bottom temperature ranging from 56.6°F. to 83.3°F. Most of the bottom temperature records of successful drags lie be-

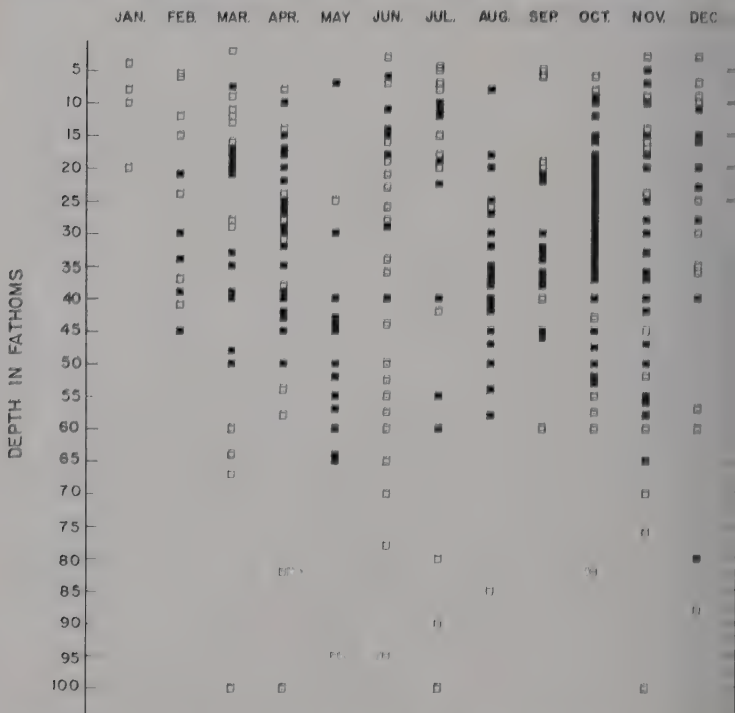


FIGURE 3. Monthly distribution by depth of trawl stations made from May, 1950, to June, 1954, by the M/V OREGON within the known range of *Stenotomus caprinus*. (■) indicates one or more successful hauls. (□) indicates one or more unsuccessful hauls.

tween 61.0 F. and 75.9 F. The variation in occurrence as related to bottom temperature is primarily due to the different depths at which the species is found. In the case of the shallower records, the water temperature varies with season. With the deeper records, the temperature decreases as depth increases. As already shown in Figure 3, *S. caprinus* has been collected in all depths within its range during all parts of the year, and therefore in a wide range of temperatures during all seasons.

DISTRIBUTION OF SIZE GROUPS

Data are not sufficient to make more than tentative remarks about the distribution of size groups in this species. Siebenaler (1952) gives an April OREGON station record in 18 fathoms off the Mississippi coast, in which he states that 1264 of this species weighed 162 pounds (an average of .13 per pound) and that these averaged 5.9 inches (approximately 150 mm) in length. There is no apparent correlation between depth at a collecting station and size of specimens shown by the OREGON records. In some cases the number of specimens and their total weight is given. However, these are often estimations in one or both cases. Data from a trip on the OREGON in May and June, 1954, show that, generally, the smaller specimens are found in the shallower portion (11-21 fathoms) of the depth range for the species and the larger specimens occur deeper. This is shown in Table 1, which lists the results of a transect run almost due east from Brownsville, Texas, in early June, 1954. It will be seen that the tendency described above is not invariable, the 11 and 15 fathom records involving specimens with a larger mean size than the 18 and 21 fathom ones. A drag made in 18 fathoms off the Mississippi River

TABLE 1

DISTRIBUTION OF SIZE GROUPS OF *S. caprinus* TAKEN ON A TRANSECT MADE IN JUNE, 1954, OFF BROWNSVILLE, TEXAS, BY THE M. V. OREGON.

Depth in Fathoms	Size range in mm total length	Mean size in mm total length	Number of Specimens
11	38-54	45.9	38
15	36-60	45.6	179
18	26-45 (+ 106)	38.6	118
21	24-48	37.5	81
23	None taken		
26	123-135	128.3	4
29	108-151	128.6	80
40	123-150	136.0	4
50-60	None taken		

Delta in mid June yielded 247 specimens showing two definite size groups, 31-89 mm and 114-156 mm total length. Four individuals taken in late May in the southern Gulf of Campeche in 19 fathoms ranged from 36 to 41 mm in total length. Further study is obviously needed before something better than the above limited generalization can be made. Data presented by Hildebrand (*loc. cit.*) from the western Gulf of Mexico are not at variance with this concept of the depth distribution of different size groups. The present evidence does indicate, however, that the distribution of different size groups does not vary materially between widespread parts of the Gulf of Mexico.

DISTRIBUTION OUTSIDE THE GULF OF MEXICO

Smith (1907: 298) and Fowler (1945: 148, 204) reported this species from the coasts of North and South Carolina. Ginsburg (1952: 100) states, however, that it actually does not occur outside the Gulf of Mexico and proposes to publish his reasons at a later date.

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A COLLECTION OF MARINE ALGAE FROM GUANTANAMO BAY, CUBA

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ABSTRACT

Forty-six species of marine algae were identified from a collection from limestone rocks near Phillip's Beach, Guantanamo Bay, Cuba. Of these, 20 apparently have not been reported previously for Cuba. This collection brings the total number of marine algae for Cuba to about 195.

The earliest published list of the marine algae of Cuba appeared in Ramon de la Sagra's *Histoire Physique, Politique, et Naturelle de l'Isle de Cuba*, 1842, in the section on botany by C. Montagne. He listed about 54 species.

In 1871, W. G. Farlow published an annotated list of 19 species of marine *Chlorophyta* from a collection of algae made in Cuba by Charles Wright in 1865-66. Although the collection totalled 46 species, Farlow never published on the other groups. Eighteen species of these green algae were new records for Cuba, only one having been listed by Montagne (1842).

Murray (1888-89) listed most of the species recorded by Montagne (1842) and Farlow (1871) and added six new records to the marine algae known for Cuba on the basis of specimens in the herbaria of Harvey, J. G. Agardh, Binder, and Sonder.

Howe (1909) added two new records to the list. Sanchez y Alfonso (1930) listed 61 species of algae from the vicinity of Havana (Guanabo, Jaimanitas, Cojimar, and Marianao) of which 35 were new records.

Taylor (1941), in a study of the marine algae of the Arthur Schott herbarium, found 23 species collected in Cuba of which six constituted new records. In a 1954 publication, he listed 113 species from Cuba which were collected by Dawson, Bartsch, Killip, and Jervis. Fifty-two of these were new records bringing the total number of marine algae reported for Cuba to about 175.

On February 7, 1954, the junior author had an opportunity to make a small collection of algae from limestone rocks in the surf and below near Phillip's Beach, Guantanamo Bay. Forty-six species were determined from this collection of which 19 (marked by an asterisk in the list which follows) apparently have not been reported previously for Cuba. These bring the total number of species of marine algae

known for Cuba to about 195, still less than half the number which may be expected to occur around the shores of the island.

List of Species

CYANOPHYTA

ORDER CHROOCOCCALES

FAMILY CHAMAESIPHONACEAE

- * *Entophysalis conferta* (Kützing) Drouet and Daily
Penetrating limestone rocks and shells in the surf.

ORDER OSCILLATORIALES

FAMILY OSCILLATORIACEAE

Lyngbya aestuarii Gomont

Entangled with *Cladophoropsis membranacea*, tide pools.

- * *Lyngbya majuscula* Gomont

Wrapped around the bases of larger algae, rocks in the surf.

CHLOROPHYTA

ORDER ULOTRICHALES

FAMILY ULOTRICHACEAE

Ulothrix subflaccida Wille

Forming a fine, light-green fuzz on stones in the surf.

FAMILY CHAETOPHORACEAE

- * *Entocladia viridis* Reinke

In the cell walls of *Hypnea musciformis* and other algae.

- * *Phaeophila floridearum* Hauck

On or in *Laurencia papillosa*, just below low tide.

ORDER ULVALES

FAMILY ULVACEAE

- * *Enteromorpha plumosa* Kützing

On rocks in the intertidal zone.

ORDER CLADOPHORALES

FAMILY CLADOPHORACEAE

Cladophoropsis membranacea (C. Agardh) Børgesen

On rocks and in loose masses in tide pools.

ORDER SIPHONOCCLADIALES

FAMILY VALONIACEAE

Anadyomene stellata (Wulfen) C. Agardh

In rock pools and below low tide where somewhat protected.

ORDER SIPHONALES

FAMILY CODIACEAE

Halimeda tuna (Ellis and Solander) Lamouroux

On a sandy bottom below the intertidal zone.

FAMILY BRYOPSIDACEAE

Bryopsis pennata Lamouroux

In rock crevices, especially where partly shaded.

PHAEOPHYTA

ORDER SPHACELARIALES

FAMILY SPHACELARIACEAE

* *Sphacelaria furcigera* KützingOn rocks in small tufts near the base of *Padina vickersiae*.* *Sphacelaria tribuloides* MeneghiniForming tufts on older portions of *Laurencia papillosa* in the lowest part of the intertidal zone and below.

ORDER CUTLERIALES

FAMILY CUTLERIACEAE

* *Aglaozonia canariensis* SauvageauOn rocks around the bases of *Sargassum* and *Turbinaria*.

ORDER DICTYOTALES

FAMILY DICTYOTACEAE

Dictyota dentata LamourouxOn rocks in shallow water. Plants with basal ramifications that resembled *Dictyerpa jamaicensis* were collected.*Dictyota divaricata* Lamouroux

On rocks in shallow water.

Dictyopteris delicatula Lamouroux

On rocks in the surf and shallow water. One of the most abundant of the brown algae at this station.

Padina vickersiae Hoyt

In patches on rocks in the surf and shallow water. Common.

Dictyerpa jamaicensis Collins

On rocks in the surf around the bases of *Dictyopteris* and *Padina*. Howe (1920) suggests that this may be the horizontal, rhizomatous part of *Dilophus guineensis* (Kützing) J. Agardh. Taylor (1954) states, "Sufficient material has come to hand from Cuba and Jamaica to demonstrate that *Dictyerpa* is a form variant of *Padina*." In our material there were basal strands attached to *Dictyopteris*

delicatula which would have been regarded as *Dictyerpa* had they been collected separately. There were also well-developed tufts without upper parts characteristic of any other genus. It seems highly improbable that this is a distinct taxon or that it is limited to a single genus.

ORDER FUCALES

FAMILY FUCACEAE

Sargassum filipendula C. Agardh

Small plants, dwarfed by wave action, were common on rocks.

Sargassum polyceratum Montagne

This species, along with *Turbinaria*, was one of the most common algae on rocks in the surf.

Turbinaria turbinata (Linnaeus) Kuntze

One of the most common algae on rocks in the surf and dwarfed by wave action.

RHODOPHYTA

SUBCLASS BANGIOIDEAE

ORDER BANGIALES

FAMILY BANGIACEAE

* *Asterocystis ornata* (C. Agardh) Hamel

On many larger algae from the intertidal zone and below.

* *Erythrotrichia carnea* (Dillwyn) J. Agardh

On *Cladophoropsis membranacea* from protected rock pool.

SUBCLASS FLORIDEAE

ORDER NEMALIONALES

FAMILY CHAETANGIACEAE

Galaxaura squalida Kjellman

Common on rocks in shallow water.

ORDER CRYPTONEMIALES

FAMILY CORALLINACEAE

Jania capillacea Harvey

On *Sargassum* and *Turbinaria*, rocks in the surf.

Fosliella lejolisii (Rosanoff) Howe

On the older portions of *Padina vickersiae*, rocks in the surf.

Variety solmsiana (Falkenberg) Taylor

On *Cladophoropsis* in protected pool.

FAMILY RHIZOPHYLLIDACEAE

Octodes secundiramea (Montagne) Howe

Common on rocks in shallow water; male, female, and tetrasporic plants. (This material was determined by Dr. E. Yale Dawson.)

ORDER GELIDIALES

FAMILY GELIDIACEAE

- * *Gelidium corneum* (Hudson) Lamouroux

Under dense stands of dwarfed *Laurencia papillosa* on rocks in the surf and shallow water.

- Gelidium pusillum* (Stackhouse) LeJolis

Scattered tufts on rocks in the surf.

ORDER GIGARTINALES

FAMILY HYPNEACEAE

- Hypnea cervicornis* J. Agardh

Occasional dense tufts on rocks in the surf and shallow water.

- Hypnea musciformis* (Wulfen) Lamouroux

One of the most abundant of the red algae on rocks in shallow water.

ORDER RHODOMENIALES

FAMILY CHAMPIACEAE

- * *Champia parvula* (C. Agardh) Harvey

Occasional small plants on rocks in the surf.

- * *Lomentaria uncinata* Meneghini

Scattered small tufts or filaments under larger algae, rocks in the surf.

ORDER CERAMIALES

FAMILY CERAMIACEAE

- * *Wrangelia argus* Montagne

Common, entangled among dwarfed plants of *Laurencia papillosa*, rocks in the surf.

- * *Ceramium corniculatum* Montagne

Epiphytic on the lower parts of larger algae, especially *Laurencia papillosa*, rocks in the surf.

- Ceramium fastigiatum* (Roth) Harvey

Entangled among tufts of *Laurencia*, rocks in the surf.

- Centroceras clavulatum* (C. Agardh) Montagne

Forming tufts on rocks in the surf.

FAMILY DELESSERIAEAE

- * *Taenioma perpusillum* J. Agardh

Occasional, creeping upon *Laurencia papillosa*, rocks in the surf.

FAMILY RHODOMELACEAE

- * *Falkenbergia hillebrandii* (Bornet) Falkenberg
Entangled within dense stands of dwarfed *Laurencia papillosa*, rocks in the surf and shallow water.
- Herposiphonia secunda* (C. Agardh) Ambronn
Creeping on rocks in the surf.
- * *Chondria floridana* (Collins) Howe
One dwarfed plant from shallow water under surf influence.
- * *Chondria leptacremon* (Melvill) De Toni
Occasional, rocks in the surf and below.
- Laurencia corallopsis* (Montagne) Howe
Occasional, mixed with *L. papillosa*, rocks in the surf.
- Laurencia papillosa* (Forsskal) Greville
This was the most abundant red alga on rocks in the surf and below where it formed dense, dwarfed stands which provided sufficient protection for a number of other algae which otherwise might not have occurred in this habitat. The plants were mostly less than two inches tall.

SUMMARY

Forty-six species of marine algae were identified from a collection made on February 7, 1954, from sedimentary limestone rocks in the intertidal zone and below near Phillip's Beach, Guantanamo Bay, Cuba. Of these, 20 apparently have not been reported previously for Cuba.

Dwarfed forms of *Laurencia papillosa*, *Sargassum polyceratum*, and *Turbinaria turbinata* were the dominant algae, dense stands of which, under the influence of surf, provided a microenvironment within which many other smaller species were able to develop.

This collection brings the total number of marine algae known for Cuba to about 195, less than half the number which may be expected to occur there.

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